DOCTOR OF MEDICINE

Tribal differences in the post-operative handover a mixed-methods study

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Tribal differences in the post-operative handover: a mixed-methods study

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This thesis has spanned many momentous events in my life. I have moved across the country from Oxford to Plymouth and from there to my current home in Glasgow. I re-commenced my clinical training in Plastic Surgery in Plymouth prior to securing my training number in Glasgow. However, the most significant change has been the birth of our son, Theodore in 2013. He has brought delight and joy wherever he goes. As I am writing this, my second child is egging me on to finish before they add to the fun of Robertson life.

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Glasgow, March 2017

Since submitting my MD thesis we have welcomed Lydia Rose in to our lives. She is a happy gentle little girl who has added immeasurable delight to our families lives.

Glasgow September 2017

Declaration

I, Mrs Eleanor Rachel Robertson declare that:

- I am the author of the thesis
- All references have been consulted by myself
- Have undertaken the work presented within the thesis
- Have not presented this work for consideration for a higher degree before

Signed:

Mrs Eleanor Rachel Robertson

I certify that Eleanor Robertson has fulfilled the conditions of the relevant Ordinance and Regulations of the University of Dundee, so that she is qualified to submit this thesis in application for the degree of Doctor of Medicine.

Signed:

Abstract

The provision of ultra-safe healthcare relies upon investment in robust systems of work. The transition of care between healthcare providers has been shown to contribute significant risk to patients, so much so that the improvement in handover was listed as one of the top five priorities for the World Health Organisation in 2014. Current handover practices have been evaluated in medicine using numerous techniques on the qualitative – quantitative continuum. The systematic evaluation of published literature revealed a paucity of evidence in relation to the optimal transfer of patient care.

As a consequence, the post-operative handover was evaluated by first undertaking semi-structured interviews of anaesthetic, recovery and surgical staff. Differences of opinion were discovered between professional groups involved in the post-operative handover. These differences have the potential to fuel inter-professional conflict. The handover process was seen as being vulnerable to the effects of outside agencies, with time pressure being most to blame. The post-operative handover was observed and a novel handover intervention was introduced, with the primary objective of reducing multi-tasking and improving information accuracy. The intervention combined education of handover error alongside standardisation of the process. The introduction of a bed-side aide memoire to separate the transfer of equipment from standardised information transfer was introduced with staff involvement.

Prior to the introduction of the handover intervention, core information points such as the patient's name and allergies were frequently omitted and the process was often beset with distraction from concomitant activities. Both of these factors improved following the introduction of the intervention.

These findings support previous revelations in handover that transitions are frequently not optimised to reduce risk in the patient pathway. However, it is feasible to ameliorate this risk by introducing a low cost quality improvement intervention which aims to standardise what can otherwise be haphazard working practice.

Publications and presentations arising from thesis

Papers

Robertson ER, Morgan L, Bird S, Catchpole K, McCulloch P "Interventions employed to improve intra-hospital handover: A systematic review" BMJ Quality Safety 2014;23:600-607. PMID: 24811239

Conference presentations

Robertson ER; Morgan LJ; McCulloch P "Is passing the baton sufficient?; A novel multi-modal technique for assessing safety and quality of handover" International Forum on Quality and Safety in Healthcare, London; 16 - 19.04.2013; Poster

Robertson ER; Morgan LJ; McCulloch P "Can a bespoke process be standardised? A phased approach to the post-operative handover" Balancing Creativity and Evidence in Patient Safety, Bradford; 20.11.2012; Poster

Robertson ER; Morgan LJ; McCulloch P "Comprehensive post-operative handover assessment" 6th International Behavioural Patient Safety Conference, Copenhagen; 01 - 02.11.2012; Oral

Robertson ER; Morgan LJ; McCulloch P "A novel technique for assessing reliability and quality of post-operative handovers: the triple assessment" Making health care safer, St Andrews; 25 - 26.06.2012; Oral

Robertson ER; Morgan LJ; McCulloch P "Who wants to be an interviewee?" Making health care safer, St Andrews; 25 - 26.06.2012; Poster

Robertson ER; Morgan, LJ; Catchpole, KC, McCulloch P “Handovers: toward a broad management and interventional framework” Making health care safer, St Andrews; 27 - 28.06.2012; Oral

1 Introduction

1.1 Patient safety and adverse events

1.1.1 Human Factors

The Human Factors (HF) view of error permits the examination and attribution of error to an authentic world model (1-7). HF is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system. In the event of an incident, retrospective analysis traditionally pinpointed the blame for the incident solely on the human operators. This person-centred model of error analysis is now widely understood to be both unhelpful, as it implies that the people involved have intended for the error to occur; and incomplete as it excludes the surrounding system from the investigative process (8-12).

1.1.2 Quantification of error

The seminal publications; 'To Err is Human' and 'Organisation with a Memory', introduced systems thinking on medical error to the national media and medical profession in the USA and the UK (3, 13). These reports were published in response to a growing realisation in healthcare of the medical profession to the serious and widespread nature of iatrogenic error. A large case note review study published in 1991 estimated that 3.7% of patients admitted to hospital in the USA were subject to an adverse event (14). This study has since been repeated in other countries with estimated iatrogenic error ranging from 3.2% to 16.6%, with over half of these events occurring in surgical care (15). The variability in the incidence of error found in this review was thought to be due to a number of factors including: definition of error; quality of medical record keeping and the aim of the study (medicolegal vs quality improvement) (15).

The Swiss Cheese model illustrates the creation and perpetuation of error through work systems, with holes representing defects in error defences which vary in size and position over time (1). This suggests that accidents are often caused by a combination of factors rather than one isolated event. The hazards in this system are considered to be in two categories of 'active' and 'latent' (1). Active hazards are dynamic and created by humans interacting with their surroundings (1). Latent hazards are those that have been built within the system from decisions made upstream by designers, architects and managers which then influence the frontline workers (1). Error may be trapped by defences termed a 'near-miss' or may penetrate all defences resulting in an adverse event. An adverse event can be defined as injury caused by medical management, rather than the disease process, which resulted in prolonged hospital stay or temporary or permanent patient harm (16, 17). Near misses can be defined as a situation which has a significant and potentially serious safety related consequence (18).

An alternative to the above is the 'three buckets model', with each bucket representing the 'self' the 'context' and the 'task' (19). This model reveals the importance of mental preparedness of the frontline workers. It underlines the importance of the frontline worker's assessment of their own abilities, their context and the task at hand. These three 'buckets' are considered to be filled with either good or bad things, with a bucket filled exclusively with good not necessarily equating with a positive outcome as the model demonstrates probabilities rather than certainty of outcome (19).

The majority of adverse events were reported in surgery specialities with a systematic review finding that median adverse events from surgical providers was 58.4% (IQR 54.5-70.9%) versus 24.1% (IQR 18.7-40.4%) for medical providers (20). Incidence for all adverse events were found to range from 51.4% - 79% (15). Others found major surgical complications ranged from 3-16% with iatrogenic mortality ranging from 0.4-0.8% (21-23).

It has been postulated that surgical care is inherently more hazardous than medical care due to the greater complexity of work systems supporting it (23, 24). It has also been proposed that adverse outcomes within surgery are harder to disguise (25). The component parts or steps are often not technically challenging, however they form an ongoing chain which must be perfect to result in overall optimum outcomes.

One of the links which is often particularly vulnerable to failure is the post-operative handover. The patient is transferred from the operating theatre to the recovery unit or intensive care and is cared for by a new team of staff. In the UK, the patient's anaesthetist and surgeon are generally immediately occupied with the next patient's needs and are often un-contactable by the recovery team. The patient is recovering from an anaesthetic and is unable to give account for themselves, leaving the recovery team completely reliant upon the information given to them during the verbal postoperative handover, the documentation and the patient's clinical signs. It is postulated that this critical handover can negatively impact the patient's ongoing care due to early miscommunication or documentation error resulting in late or incorrect treatment.

The findings from industrial disaster investigations and litigation analysis demonstrate the relationship between handover error and harm (26). However, when attempting to quantify the actual amount of error attributable to handover inadequacies, the volume is likely to be significantly higher. This systematic underreporting is known as the patient safety iceberg, whereby the tip is reported preventable adverse events, followed by unreported preventable adverse events, then near misses and finally non-harm incidents (27, 28). It has been estimated that between 22-96% of adverse events are not reported (29). For every reported adverse event, it is thought that 300 near misses have occurred (30).

1.1.2.1 Incident reporting

The recognition and quantification of error with subsequent allocation of causation is a notoriously difficult process (17). The interrogation of harm/adverse events with retrospective analysis techniques may pinpoint a number of causes. However the retrospective analysis of both error and adverse events is susceptible to reporting and analytical bias (31). Reporting bias, where some incidents are reported more reliably than others has long been acknowledged. It has been estimated that only 6% of adverse drug events are reported to incident reporting systems with pressure sores and failure of risk assessment completion being less reliably reported (32, 33). The reasons for this systematic under reporting are numerous and include: lack of feedback (33, 34); concerns over confidentiality (34) ; retribution (35) and a perceived lack of time (34).

Outcome bias has also been implicated in the falsely low reporting of incidents. Outcome bias is a phenomenon whereby individuals are influenced in their assessment of an event by the subsequent outcome (36). It has been demonstrated that if an undesirable or untoward incident arises within a process, but the outcome is favourable, there is a high chance that the incident would not be reported, with the reverse also being true (37, 38).

These biases reduce the opportunities for systemic learning and improvement as the frequency of incidents occurring within an organisation remains hidden. Near misses or sentinel/warning events provide perfect opportunities for organisational learning and system engineering as they occur frequently; in addition, because no harm occurs, the influence of blame culture rather than Just Culture is less likely (39). A just culture can be classified as one where frontline operators are not punished or reprimanded for reporting omissions, commissions or decisions which are in line with their professional grade and training, however intentional disregard of procedure or protocol is not tolerated (40).

1.1.2.2 Improving incident reporting

A Cochrane review investigated the effects of interventions aimed at improving incident reporting (41). They found one study with a sustained, but non-statistically significant improvement in incident reporting rates by adopting a Just Culture as well as recruiting frontline staff in the incident analysis process (9, 42). The introduction of an electronic reporting system in and of itself failed to improve incident reporting (43). Another online reporting form which generated automatic reminders to reporters caused an overall decrease in incident reporting (44). The final intervention which was included in the Cochrane review consisted of a multi-component intervention of: educational package; Just Culture initiative through anonymization of reporting; improved ease of reporting and investigation feedback (45). This intervention was found to produce a statistically significant increase in the number of errors reported (additional 60.3 reports/10 000 occupied bed days (OBDs); 95% CI 23.8 to 96.8, p0.001) (45).

Once an incident has been reported, an investigation of the incident's root causes should be undertaken. This process is vulnerable to hindsight bias as the investigator is unable to witness and experience the individual influences that occurred in the lead up to the incident(Figure 1) (46, 47). Hindsight bias may result in inaccurate assertions being drawn and ineffective safety barriers being constructed.

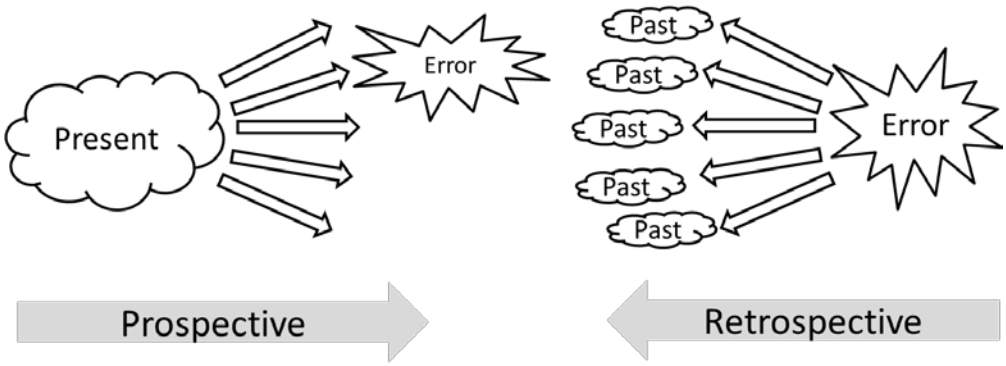

Figure 1 Hindsight bias (based on Le Coze 2008) (46)

The analysis of reported incidents has previously been viewed as a panacea for all error however the reported incidents represent a minority of actual harm occurrences in healthcare (31). A holistic approach would include the investigation of both latent and active system errors (1, 48). Latent errors are those designed into the system, such as the layout of the hospital or shift patterns, as opposed to active system errors which relate to more volatile players such as humans (1). This prospective approach to error analysis would require investment in systemic investigation, utilising HF techniques.

A study investigating the preventability of healthcare adverse events found half of all adverse events were preventable. The notion of 'preventable' vs 'unpreventable' error raises differences of opinion within the medical community. The notion of a 'preventable' error is contentious in the healthcare community. Indeed in a survey questioning both healthcare professionals and members of the public, only half of those questioned considered that adverse events could be classified as preventable (49). For an event to be considered avoidable the for prevention means should exist within the system at the time of the event, unless it was not considered standard care (16). As this definition is open to interpretation, most studies which set out to evaluate the incidence of preventable adverse events do so in a blinded fashion, with two independent reviewers (50). It is accepted that

the proportion of preventable adverse events is increasing as awareness of the effect of systems upon patient outcomes increases (51).

It has been recommended that investigators do not rely upon a single harm quantification method as little overlap exists when more than one method is used to quantify harm. A study comparing three methods of harm quantification compared pharmacist reported near misses or harm events; case note review and incident reports and found little overlap (52). Of 288 consecutively discharged patients from 6 wards there were: 11 incident reports (3.8%), 30 pharmacists' reports (10.4%) and 65 harm or near miss incidents collected on case note review (22.5%). Only 4 patient harm episodes were captured in >1 method.

Another study investigated the relationship in the reporting reliability of: patients, physicians and nurses in comparison to case note review of medication errors and found little overlap between the methodologies (Figure 2) (53).

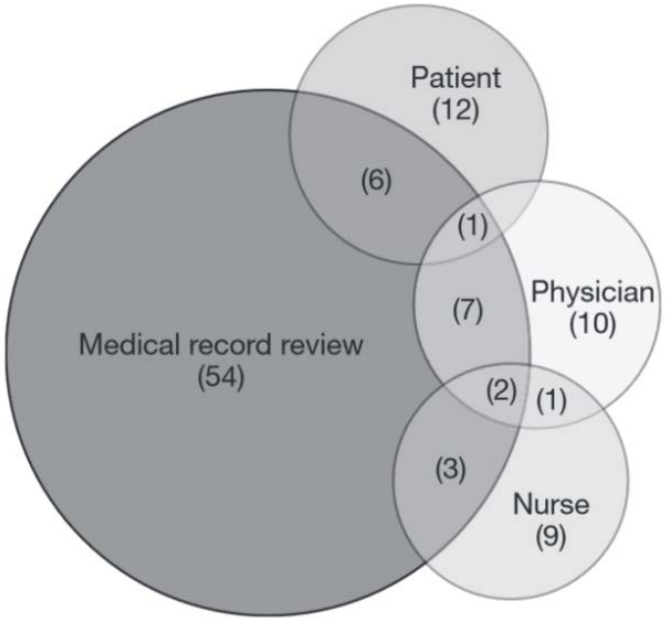

Figure 2 Medication errors: incidence of error as reported by patients, physicians, nurses and medical record review (53)

These studies have demonstrated the weaknesses in incident analysis and the bias created through the selection of investigative methods. These findings are pertinent for the investigation of handover-related error as, even in relatively clear cut, well defined incidents such as medication errors, the rate of accurate and reliable reporting is low. As handover is often generated at a temporal or physical distance from the patient's bedside, it is often omitted in incident analysis and improvement recommendations.

1.2 Patient handover

'*Handover of care is one of the most perilous procedures in medicine, and when carried out improperly can be a major contributory factor to subsequent error and harm to patients. This has always been so, but its importance is escalating with the requirement for shorter hours for doctors and an increase in shift patterns of working*.' (54)

1.2.1.1 Interview studies exploring adverse events and error

1.2.1.1.1 Of staff

Due to systematic under-reporting of near-misses and adverse events, interview and survey techniques have been employed to understand the frequency of and contextual background to healthcare errors. An interview study of 26 doctors at one hospital found a strong relationship between communication problems and medical 'mishaps' (55). In another study, a confidential survey of 158 (81% response rate) junior paediatric doctors found that 31% reported at least one unexpected event during their last oncall period (56). Had these foreseeable instances been handed over the perception of preparedness for the shift ahead would have improved (56). Another survey of 821 (57% response rate) junior doctors at two teaching hospitals found a 5% of self-reported adverse events were as a consequence to errors in handover or patient cross-cover (57).

1.2.1.1.2 Of patients

Patients have been surveyed and frequently find the lack of continuity of care frustrating and baffling: *'"They keep asking the same questions—already answered and documented by my general practitioner", "Too many doctors! A second opinion is OK, but the sixth and seventh are quite frustrating" and "You always get different orders from new doctors"'* (58). With the aim of elucidating the markers of quality care from a patient perspective, a survey of 3592 recently discharged patients found that coordination and continuity of care were amongst the most important factors listed (59). Patients were found to be a reliable in recognising and reporting adverse events during inpatient stay (25). 17 patients (8%) reported 20 adverse events and 8 (4%) experienced 13 near misses. The majority of adverse events (55%) were documented in the medical notes but not on the hospital incident reporting system (25).

1.2.1.2 Paperwork analysis

The analysis of the paperwork which supports the handover process can be considered as an investigation of one aspect of the latent system supporting effective handover. A retrospective cohort study compared the information recorded about medications in charts and the handover sheets (60). Of the 165 included patients there were 6,942 medication entries and 27% medications contained discrepancies with 80% of these labelled as omissions. Although commissions (or errors) were more likely than omissions, (68% vs 53%), a high proportion of both of these error categories were deemed to moderately or severely harmful (38% commissions and 11% omissions) (60).

1.2.2 Handover definition

The handover or handoff process is an industry-spanning, critical task which aims to ensure continuity of service delivery in the context of multiple changing variables. The core constituents of handover are the transfer of both task-relevant information and responsibility between workers (61). Transitions in shift operators were initially modelled as a continuous process with little impact on output or process safety (Figure 3) (62). This model was updated to reflect handover complexity with a description of: outgoing staff reduction in activity during incoming colleague briefing with associated decrease in activity and situational awareness (Figure 4) (62). This handover process requires significant time investment, both prior to and during the meeting.

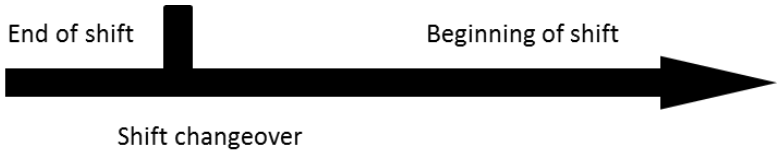

Figure 3 Traditional model of shift handover, activity stable (based on: Grusenmeyer 1995) (62)

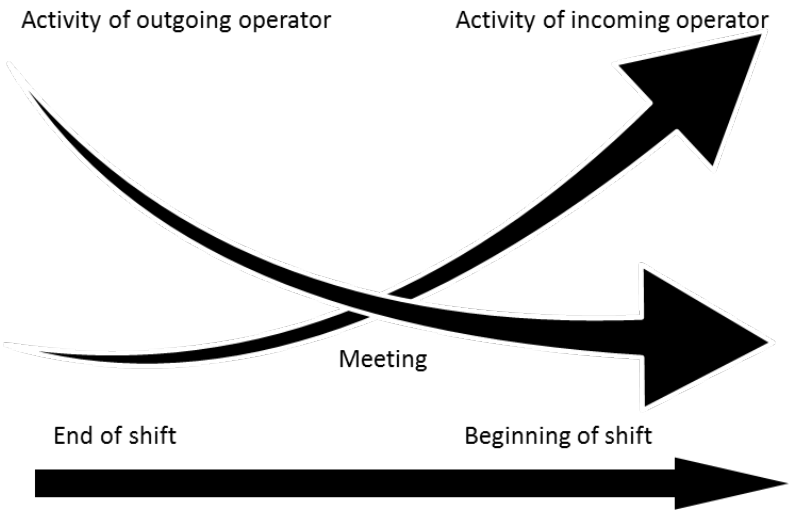

Figure 4 Revised model of handover, revealing the loss in output associated with shift handover (based on: Grusenmeyer 1995) (62)

Handover is not a process that adds value, except when explicitly engineered to do so, in-fact from the service-provision point of view a hallmark of a successful handover is a seamless continuity of work activities.

There is as yet no universal definition to describe the act of clinical handover, indeed the terminology often varies within the medical literature and uses such terms as: shift change; handoff and transfer (63). The British Medical Association (BMA) defines clinical handover as: *'The transfer of professional responsibility and accountability for some or all aspects of care for a patient, or groups of patients, to another person or professional group on a*

temporary or permanent basis'(54). The provision of safe, accurate medical handover is mandated by the General Medical Council (GMC) in Good Clinical Practice, section 48 '*You must be satisfied that, when you are off duty, suitable arrangements have been made for your patients' medical care. These arrangements should include effective hand-over procedures, involving clear communication with healthcare colleagues.'* (64).

Handovers permeate the entire modern health-care system and have become integral in supporting the delivery of sophisticated specialised clinical care (65). Handovers occur at: shift change; ad-hoc breaks; patient inter-hospital transfer and inter-disciplinary referrals (66) and can be categorised using the following framework:

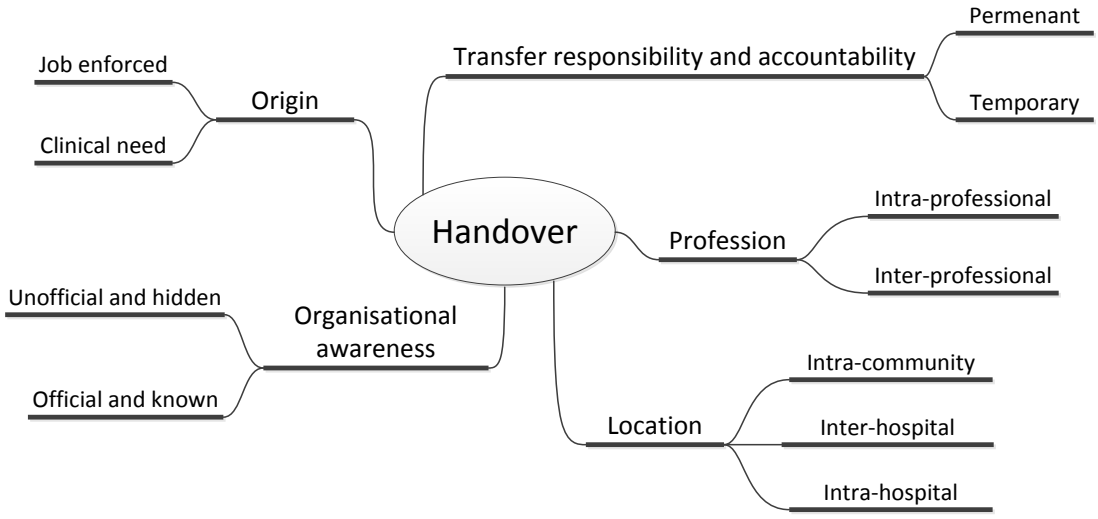

Figure 5 Taxonomy of clinical handovers

This schematic enables the framing of handovers as: temporary (e.g. break cover) or permanent (e.g. patient relocates GP transfer); inter-professional (e.g. transfer from paramedic to triage nurse in accident and emergency) or intra-professional (e.g. shift

handover); intra-hospital (e.g. speciality transfer), inter-hospital (e.g. from nursing home to acute medical ward) and intra-community (e.g. sheltered to nursing home); official (e.g. shift handover) or unofficial (e.g. break cover) and finally as clinically required (e.g. inter-speciality transfer due to changing diagnosis) or due to system requirements (e.g. shift change due to mandated working time).

The requirement of continuous care provision, combined with working hour restrictions has resulted in an increase in the frequency of handovers. Following working time limitations, one organisation reported an 40% increase in resident doctor handovers, with an average 5 day inpatient admission resulting in 15 physician-to-physician handovers (67). When nursing handovers are included it has been postulated that 24 handovers would occur (68). It has been estimated that at one teaching hospital in the USA a total of 4,000 handovers occur a day, amounting to 1.6 million per year (69), with an estimated half a billion per year occurring in the USA (70). From a patient perspective, this translates to a patient consulting with an average of two primary care physicians a year, and if suffering from a chronic condition, greater than 16 physicians per-year (71, 72).

It has been recognised that the traditional model of one doctor to patient relationship, the concept of 'my doctor or my patient' (73), has changed to one where care is delivered by numerous healthcare professionals and coordinated by two or more overseers (74). The paradigm of care coordination can be defined as '*the deliberate integration of patient care activities between two or more participants involved in a patient's care to facilitate the appropriate delivery of health care services'* (75). This new paradigm has occurred within the 'front stage' i.e. what the patient experiences and the 'back stage' system supporting the delivery of care (76). Lack of coordination in the transfer of the trauma patient has been shown to contribute to a significant number of 'flow disruptions' (deviations from the a procedure which potentially compromises safety or efficiency) in the delivery of care (77).

The study in question used trained observers to collect both number of transitions and 'flow disruptions' of 181 patient's care pathway through accident and emergency. They found that patients with more complex care needs (e.g. admission straight to intensive care or theatre) were more likely to experience a flow disruption (77). They felt that these transitions were most at risk due to their sporadic occurrence and non-standardised process.

The overriding purpose of handover is to prepare the incoming worker for taking responsibility of a dynamic, event-driven and complex setting (78). The success of timely-delivery of care relies upon seamless interactions between: patient derived information; the provision of adequate resource and the results from on-going investigations (Figure 6) (79). Using this model it is possible to see that handover is the generic endpoint of multiple systems and the effect of poor handover is the potential for wide-ranging and significant sequelae (e.g. poor handover of medication resulting in prescribing error) (80).

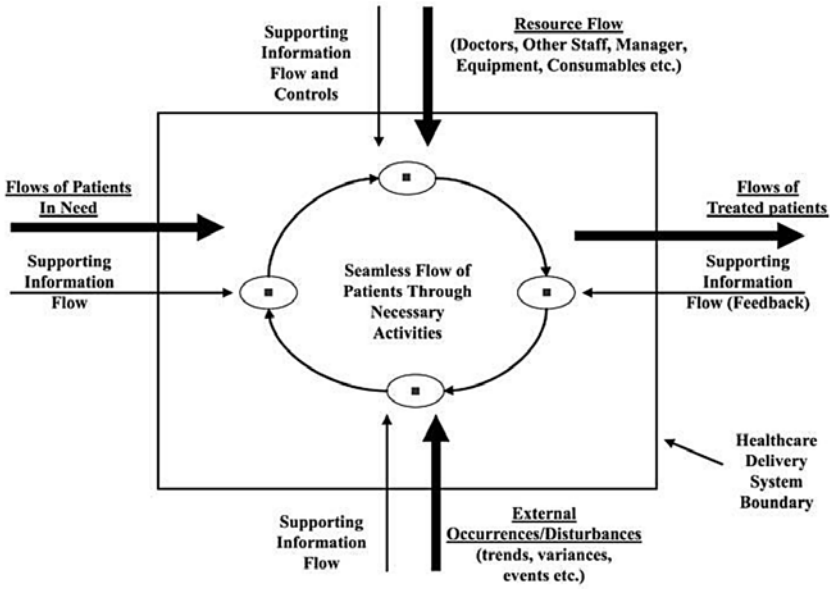

Figure 6 Patient pathway through healthcare system. Inbound flows and dependencies displayed.(79)

Various analytical frameworks have been developed to produce unified assessment methodologies. Handover success or deficiency has been defined in three broad categories: level of operation; elements of handover and measurement (Figure 7) (81). The measurement of 'levels of operation' handover success include an assessment of adverse events; an evaluation of process quality and productivity (78). The reasoning behind the selection of these outcome measures is the recognition that poor transfer of care can result in direct patient harm, as measured by adverse events, as well as process outcomes such as re-admissions. The analysis of handover micro-processes include: information handover, in verbal and non-verbal formats; rating of teamwork, especially situational awareness and the impact of the surrounding environment on the process, e.g. distractions and interruptions (78, 81, 82). The third element is to evaluate compliance of handover practice against pre-existing standards (81).

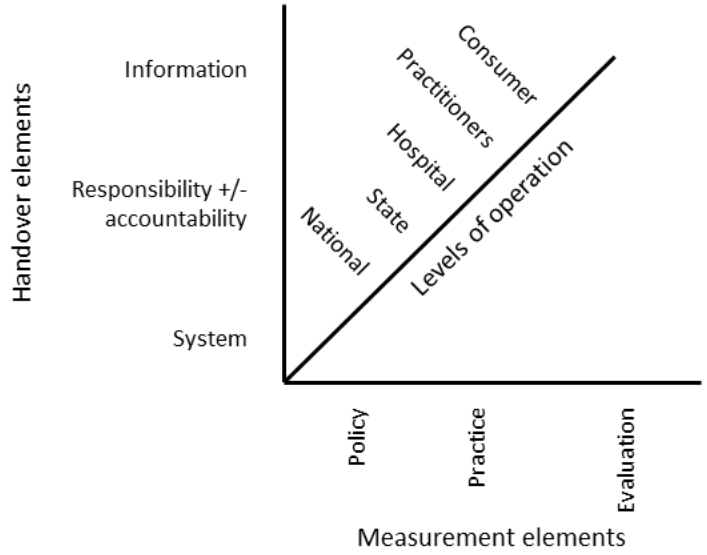

Figure 7 Measurement of handover after: Jeffcott 2009 (81)

1.2.3 High profile accidents associated with handover

Effective handover is an essential component of many industries including: the petrochemical, nuclear and aviation (83). Deficiencies in handovers have been attributed in the creation and exacerbation of a number of high profile industrial disasters. Systems of work were investigated following the 1988 Piper Alpha North Sea oil platform disaster, in which 167 crew-members perished. It was found that flaws existed in the 'permit to work' handover system which was meant to clearly define the working status of the oilrig. Work had commenced on one of the two pumps, however the 'permit to work' was misplaced from the oncoming team. The line manager requested that the pump be started which was a major contributor to the initiation of the gas-leak and subsequent explosion (26, 84).

Similarly in 1983 at, Sellafield nuclear site highly radioactive particles were released onto a beach due to misinterpretation of handover documentation by the incoming shift workers (85, 86). Two years following the release a 14-fold increase was observed in the incidence of leukaemia and non-Hodgkin's lymphoma in a local town (85, 87).

In aviation, the 1991 Continental Express Flight 2574 crashed in Texas, resulting in 14 fatalities. The National Transportation Safety Board (NTSB) attributed the crash to the inadequacy of the mechanic's handover in the maintenance of the stabilizer de-ice boots which resulted in sudden nose-down pitch over and airplane brake-up (88).

Another, more recent study of aviation mechanic errors found 50% of all communication errors originated at handover, resulting in 4% of total maintenance errors (89). Air traffic control handover errors were found to result in severe consequences such as: plane diversion; declaration of emergency and failed take-offs (89). Another study, investigating the relationship between air traffic control shift time commencement and operational errors found that nearly 50% of all operational errors were reported within the first 30 minutes following handover (shift change and break cover) and decreased with time on shift (Figure 8) (90). There was a statistically significant correlation between time on shift and error. The staff returning from breaks were found to be at highest risk of committing an error (47%) (90).

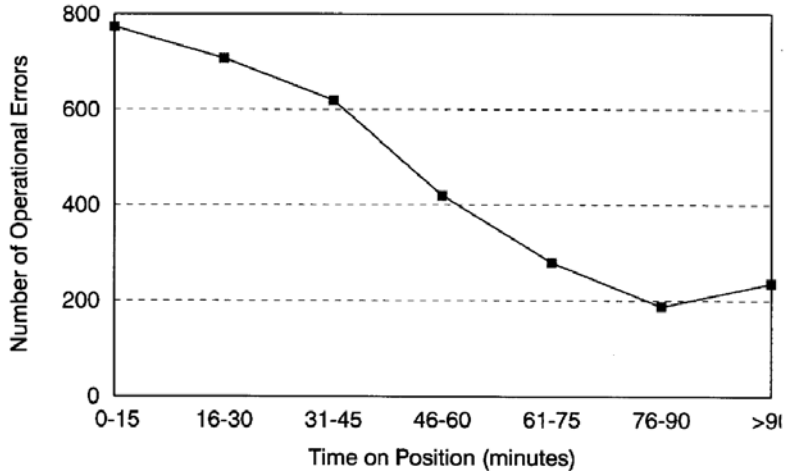

Figure 8 Total number of operational errors reported by air traffic controllers compared to the amount of time on position 1988-1994 (90)

It is possible to consider these findings in relation to the model proposed by Grusenmeyer (62), whereby when work activity decreases and the number of reported errors increase around the time of handover (Figure 3). If this is considered within the context of healthcare where a patient is handed over 24 times during an admission, each handover generates a ripple of error, akin to a wave on a pond, creating ever increasing amount of error and influence throughout the healthcare system. The error from handover lies in tension with that from fatigue.

1.2.4 Healthcare

In healthcare, the evidence of wide-spread mortality and morbidity due to handover error is lacking. To deal with this issue, surrogate measures have been developed which attempt to quantify harm at different stages in the process. Three overarching categories have been described: latent errors, active errors and adverse events and methodologies developed to quantify the deviation from practice and harm (Figure 9). In this scenario, errors are

defined as near misses, mistakes and close calls whereas adverse events describe an event which has lasted in temporary or permanent patient harm (17).

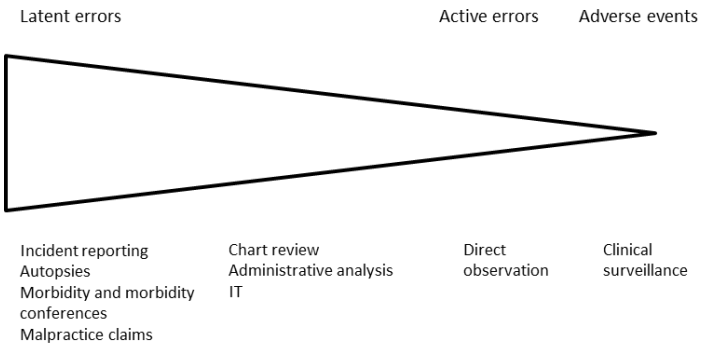

Figure 9 More than one method to detect adverse events, after: Thomas 2003 (17)

Every care transition creates opportunities for error, with these directly impacting upon patient safety by generating discontinuity of care, leading to adverse events and subsequent malpractice claims (91-93). Communication defects have been found to be the root cause of 26 – 31% of healthcare incidents (94).

It has been found that a higher proportion of adverse events (26% compared with 12% [odds ratio, 3.5; p = 0.01]) occurred when a patient was being cared for by a cross-covering physician (95). A review of incident reports revealed that 2% of reported adverse events were attributable to communication break-down and flaws in the handover process (30). An analysis of patients who died within 96 hours of hospital admission found communication problems to contribute to 13.5% of the deaths (96). It is suspected that this is likely to be less than actual occurrences due to generic incidence reporting bias as well as the nature of handover being a hidden component in a complex system.

Assessment of malpractice claims has long been used as a proxy measure for patient morbidity and mortality (17, 28, 97). An investigation of medical malpractice claims on doctors in training in the USA revealed 34% of successful claims were due to handover error (98). These malpractice claims were due to handover error between doctors (a third of cases) with the remainder involving other hospital processes including: laboratory, nursing and pharmaceutical staff (98). Another study analysed medical malpractice claims from 4 malpractice insurers found communication breakdown to be the root cause of over 25% of cases (99). The precise nature of this communication breakdown was investigated and it was shown that within these communication failure cases, 43% of the failures occurred at patient handover (100).

1.2.5 Handover system

In its pared-down state the task of handover is fundamentally a human-to-human interaction relying upon: input, process (communication) and output (I-P-O) (101). The sender-receiver model enables the visualisation of an essentially neurological process whereby the sender has an activation of their neural cells which is then encoded into appropriate language and then decoded and interpreted in the context of the receiver's pre-existing patterns (102).

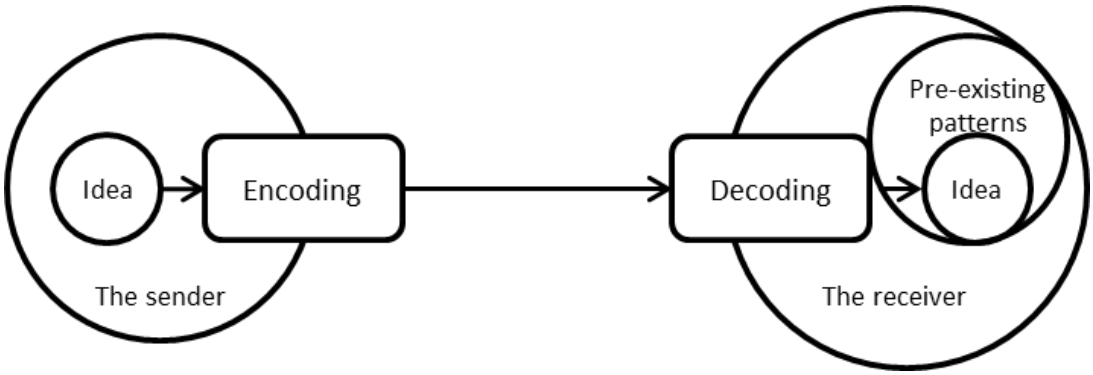

Figure 10 Sender receiver model of human-to-human interaction, after: Denzau 1994 (102)

This discrete process, which can be examined from a psychological view-point, is nestled within a wider, ever-changing organisation which directly influences the quality of the handover (92).

The Systems Engineering in Patient Safety (SEIPS) model elegantly demonstrates the dependant relationships, both within and between component categories (Figure 11) (103). It also further explains Donabedian's model whereby the effect of the work systems impact upon care quality outcomes (48). The consideration of error generated both within and between these individual components enable a pre-adverse event investigation of the systemic risk (104).

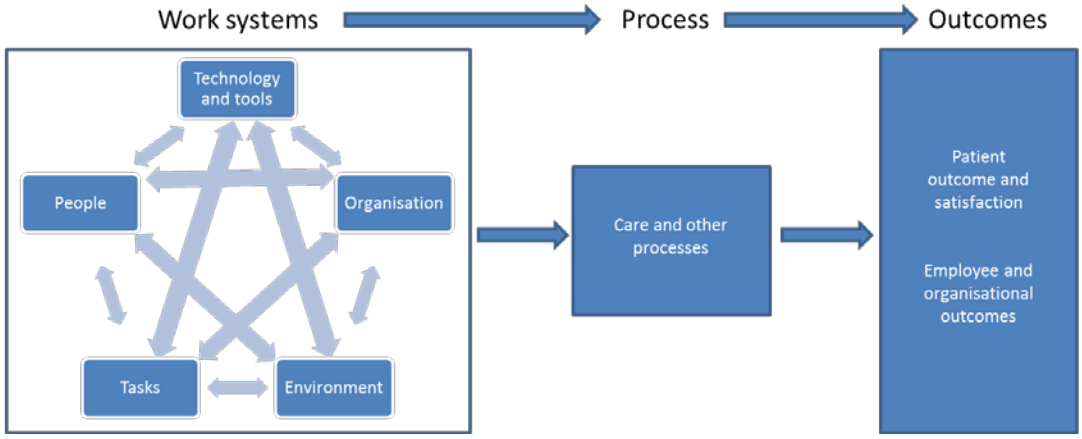

Figure 11 Systems Engineering in Patient Safety (SEIPS) (after Carayon 2006) (103)

The direct quantification of handover-related error is complex, however one study evaluated the origins of reported incidents in intensive care and found that 32% of reports had contributing factors from communication error, with nearly half of these arising from handover (105). A study which evaluated the introduction of a complex handover quality improvement intervention found a significant reduction in both total error ($P < .001$) and preventable adverse events ($P = .04$) (106). Although not directly analysing the effect of poor handover on patient harm, this quality improvement intervention effectively demonstrated the impact that handover generated error can have on overall patient harm.

1.2.6 Prospective analysis of handovers

An observational study of 88 shift handovers between doctors investigated the reliability of the verbal and written information (107). They found a statistically significant relationship between clinician cross-cover (i.e. doctors caring for other team's patients) and omissions of both clinical information (mean 43.2% of patients vs 57.3%, p=0.007) and planning information (0.42 statements per patient vs 0.56, p=0.02) (107). It was found that

sequential handovers increased the distortion in important clinical information in 46/211 of cases (107). The recipient of the handover only noted an omission or error if an adverse event occurred (107).

Within the nursing community, Sexton et al. conducted detailed content analysis of 23 nursing handovers in an Australian hospital (108). They found that over 95% of transferred information was also held within the medical record. In comparison with the generally held belief, the authors felt that some handovers increased rather than decreased confusion and often did not clarify issues regarding patient status, treatments or management (108).

1.2.7 Interview studies in handover

The field of healthcare handover has been explored using qualitative methodologies from ethnography to structured interviews (109). Debate remains as to the overarching similarities and differences between clinical handover: the 'lumpers' who consider commonality exists which translate between environments; and the 'splitters' who consider each handover to be niche which requires examination in their own right (110, 111). It is likely that truth lies somewhere on this continuum, where a core commonality between handovers can be found and improvement interventions adapted at the local level to adapt to the local environment (112, 113).

In the following section I will summarise findings from previous qualitative research in medical handover, placing emphasis on handovers that can be considered similar to the post-operative handover: inter-professional handovers, where the patient is unable to contribute directly to the process and within a hospital setting.

1.2.7.1 Ethnography

1.2.7.2 Emergency department

The Emergency Department (ED) handover has been explored by ethnographic researchers. The transitions of care within ED are directly comparable with the post-operative handover with similarities seen in all domains of the SEIPS model: people, inter-disciplinary; task that is, complex and high risk; prominent use of technology and tools with, reliance on monitors and anaesthetic equipment; organisation characterised by, handover fitted into existing working practice (103). Ethnographic studies frequently employ triangulation techniques where ethnographic observation is supported by an alternate data source including: unstructured interviews (114) and surveys (115).

An ethnographic study combining observation of 64 handovers with 20 unstructured 'conversational-style' interviews found four main influencers as to the quality of the handover (114):

1. Interruptions: *"Different people come over to the same patient and ask about the same information and nobody seems to relay the information to each other…that's how medication errors are made"*(Paramedic, participant no. 4)
2. Workload: *"I had to wait around because they were so busy in there. There was no one to handover to and I couldn't leave the patient alone."*(Paramedic, participant no. 24)
3. Relationships: *"I try not to make assumptions based on (paramedics') handover or what is said or how it is said. I try to remain open and assess the patient for myself while listening to the handover"*(RN, participant no. 251).
4. Responsibility: *"..you know, sometimes they just leave you there and go off and do other things and forget about us…"*(Paramedic, participant no. 31).

The authors felt that these four core difficulties in handover were due to defects in the design of the system and wider organisation as well as unique individual factors. They noted that although aide-memoir systems had been provided by the institution (whiteboards), these were not consistently used resulting in an over-reliance on practitioner memory leading to omissions of key information for the patient's onward care (114). As the observations of the paramedic to ED handover were made whilst also collecting data on the local context and environmental factors, inferences as to the effect of the environment of the handover as well as the wider system on the handover's success were observed and made. These rich data provided the opportunity for change recommendations, such as instigation of electronic handover tools (114).

Another study triangulated ethnographic observations of 311 paramedic to ED staff handover with survey responses from ED staff (115). The researchers found that the majority of paramedics performed two handovers (90%, 95% CI 86.5–93.2). Less than 50% of ED staff referred to the paramedic documentation following the handover, despite the majority of them stating that this was important, useful and accurate (115). The researchers also noted there was a separation between the medical team and the paramedic staff with most lower triage category patients being handed over to a nurse and then to a doctor, necessitating an additional handover. This study was able to tease apart and observe differences in the ED team's reported behaviour and their daily practice. The survey respondents stated that information was missing from the verbal handover 67% of the time, with supplemental questions being asked in the observed handovers 72% of the time. This difference is of interest as it may suggest that even with opportunity for questions ED staff were dissatisfied with the content of the verbal handover. The authors suggested an alteration to the ED's working practice by permitting triage of patients by the paramedic team. This time and handover-saving initiative was dismissed despite the ED staff reporting that the paramedics were trusted and valued (115).

The ECHO (Emergency Care Handover) study recorded over 200 handovers within the ED and categorised the content as to whether it was of a physiological, psychological or social nature (116). They found that the majority of the handovers omitted mentioning elements of the patient's psychological or social background thereby limiting the effectiveness of the transfer from the community to hospital.

An ethnographic study of ED shift and paramedic to ED handovers in five hospitals in USA and Canada collected audio recordings of selected handovers and investigated observed incidents (111). The researchers found wide heterogeneity between the observation sites such that they were unable to develop a standardised data collection approach. They unveiled an acknowledged trade-off which the frontline staff regularly made between one aspect of improving the handover, for instance moving to a quieter location, versus another, such as being in line of sight of the patient. They also found that the handovers had changed little and were not prone to improvement techniques or experimentation. The researchers did note that the handovers were not 'data dumps' but rather a time for conversation between the incoming and outgoing primary care giver and indeed this time was used to construct an ongoing care plan. Based on their observations, they drew parallels between the ED handover process and other industries, such as cafeterias, and felt that the type of work they were observing represented low standardisation and jumbled flow. They felt that this parallel was appropriate given the required high level of flexibility required with the trade-off being increased time and cost due to the longer than required time to complete the task if it was a scheduled event. In addition to this modelling comparison, they described the function of handover as one greater than just information transfer; they concluded that handover was in fact reliant upon transfer of responsibility, vulnerable to the effects of hierarchy, relying upon cooperation and a shared understanding of a patient's condition.

It is clear that the ethnographic approach has enabled the evaluation of the transition of patient care within its context. Through these evaluations, the research studies were able to reflect current practice as well as begin to collate observations between sites, and correlate findings to parallel industries. These insights have enabled future researchers to delve into these preliminary findings to explore deeper meanings within the same context and similarities to other clinical environments.

In an ethnographic study of post-operative handover, forty five transitions between the operating theatre and the recovery room between 17 anaesthetists and 15 recovery nurses were studied. The researchers found a lack of consistency between each handover, with variation seen in: the location (theatre, corridor and recovery); concomitant activities (monitoring attached, readings and recordings taken and drugs prepared); the time between arrival in recovery and handover start and the number and type of people involved (117). The handovers observed were seen to be brief and focused on information relating to: pre-operative health, intra-operative events and medications delivered. The anaesthetists assumed knowledge on the recovery nurses' behalf by frequently referring to *'my usual'* (meaning my usual anaesthetic and post-operative care requirements). They observed intra-operative complexity and difficulties were often made light of in the handover. The recovery nurse was seen as an active participant in the handover by requesting more information. Documentation was observed to be referred to and added to after the handover but there was no formal documentation of the handover. The observers noted that the arrival in recovery signalled a stop and check or audit point for the recovery nurse, who generally proceeded to check for documentation completeness and ready themselves for the onward handover to the ward. The colloquialism for the end of the handover process was a *'happy?'* from the anaesthetist to the recovery nurse. Recovery nurses were observed avoiding a direct contradiction, instead asked for the anaesthetist to stick around, with the anaesthetist complying until the patient woke and the anaesthetist

asked *'OK?'* and then departed. The researchers related this behaviour to the nurses' influence on safety through the moderation of the anaesthetist' practice. This practice was expected with the senior nurse volunteering at interview that they matched the recovery nurse with the anaesthetists. The reluctance to directly address behaviour which may be viewed as less than satisfactory was related to the maintenance of the anaesthetist's 'face' by the nurses to maintain healthy ongoing working relationships. They concluded that in the highly standardised and safe profession of anaesthetics, there still exists an element of non-standardised work (117).

1.2.7.2.1 Summary

The study of handover through observation of work has revealed a precarious system which is vulnerable to interdisciplinary misunderstanding and communication. The studies also revealed tensions between treating patients and providing clear handover. It is frequently an unstructured process which relies upon system adjuncts such as written documentation to prevent patient harm.

1.2.7.3 Interviews

Building upon the ethnographic work of handovers, researchers looked to explore factors which mediate handover success and failure. In one study, 6 ED nurses were asked to describe a 'typical day' with these experiences then being harnessed in subsequent interviews to explore the paramedic to nurse handover process. Following the analysis of the nurses' typical day, four main themes were developed around the pre-hospital reporting, symbolic, ideal and non-ideal handover. The themes of preparedness, perfunctory/absent handovers, job affirming experiences and non-ideal handovers were drawn out from the interviews (118). This study revealed the impact of the clinical condition of the patient in the transfer on the handover. The nurses described an ideal handover as one where the condition was clearly defined at presentation with the

handover delivered confidently and succinctly. The overall findings of the paper reveal that the majority of handovers occur in a very short period under time and stress pressure which conflicts with the nurses' desire to receive a holistic view of their patients.

The ED paramedic to clinician handover was evaluated by means of a semi-structured interview technique comparing the experiences of staff on 'both sides of the fence' with 50 interviews being undertaken with paramedics (n=19), nurses (n=15) and doctors (n=16) from 2 hospitals (119). The interviews were analysed using a positivist framework, meaning that truth can be found from research, for commonality between sites and participants. This resulted in three common themes of:

1. difficulties in creating a shared cognitive picture
2. tensions between 'doing' and 'listening'
3. fragmenting communication 'Chinese whispers'

The interviews revealed tensions between the incoming paramedic attempting to relate the patient's context and the difficulties experienced by the receiving team in processing the perceived jumble of verbal, written and observed information. They both independently suggested that this may be due to a lack of shared language. Another tension related to the pressure on the receiving clinicians to assess and treat the newly arrived patient with the paramedic's need to handover critical verbal information. This tension resulted in the paramedics feeling ignored and repeating the handover multiple times. The paramedic team spoke about the physical ownership of the patient being linked to being listened to, with some only permitting transfer from their trolley to the ED bed once the verbal handover has occurred as they noted that once this has happened they had *"lost the upper hand"* (120). This ongoing practice of multitasking was in contrast to the professed belief by the paramedics and receiving clinical staff that listening to the handover was essential for safe delivery of care, with one doctor feeling that the onus lay with the

paramedics to ensure that they were listened to. One startling commonality between the interviews was the spontaneous use of the term '*Chinese whispers*' by 20 interviewees. This term related to the degradation of information through multiple pairs of hands before the end-user (the clinician who will care for the patient) receives the parcel of information. Some interviewees noted that handover occurred continuously throughout the patient's initial assessment in ED due to the constant staff change. This study revealed inter-disciplinary frustrations relating to the handover process, with both sides frequently regarding it as sub-optimal from a professional standpoint as well as patient safety.

A Danish study sought to gather opinions on care transitions within a whole hospital, from physicians, paramedics, nurses, radiographers (total n=47) from departments including ED, medical, surgical, ITU, radiology and ambulance stations (121). A critical incident technique was utilised to gather information on failures in handovers. Critical incident analysis seeks to collate observable human behaviours into broad psychological principles with an aim of solving problems (122). Through the analysis of the interviews eight central barriers to safe handover were elucidated: communication, information, organisation, infrastructure, professionalism, responsibility, team awareness, and culture. The researchers found that the interviewees did not consider handover as a safety critical step and that the process was influenced by different cultural influences throughout the hospital. The conclusion of the interview study was to make recommendation for system change to support safe handover through the introduction of organisation-level quality improvement (infrastructure, organisation, and culture categories) interventions (121).

A semi-structured interview study was undertaken to evaluate the transfer of patients from the pre to post-operative phase. The aim was to elucidate from surgeons, anaesthetists and nurses reasons for information failures within the theatre suite and possible interventions which could be deployed to reduce them (123). The post-operative handover was found to

have three overall reasons for failure relating to source, transmission and receiver failures (123). Overall, the healthcare professionals considered that the post-operative handover failed due to information issues – it was: missing, scattered, incomplete or overloaded.

The handover from ED to critical care is one which involves the transfer of critically unwell patients who are frequently dependent upon complex fluid and drug regimes. This handover between ED and ICU nursing teams was explored at two hospitals with three nurses from each ED and ICU recruited and interviewed at each site. The interview questions were generated from focus groups of ED and ICU nurses and included: the commencement of the handover; patient arrival in ICU; information transfer; influence of experience and attitudes of nurses and a critical event (124). The interviewees offered suggestions as to what they expected at the handover with regards to verbal information transfer and the availability of documentation. There was a recognition from the ICU team that the ED nurses were under significant pressure and were quick to point out that they in no way blamed the ED staff for omissions or errors but felt that a structured approach would aid the handover. They also recognised that there was often too much work to be done at the time of the handover and that having an extra nurse at the bedside to 'sort the machines' and let the other members of the team proceeded with the handover would benefit the process.

1.2.7.3.1 Summary

Interview studies have enabled the gathering of information on handover in a structured way. They have further highlighted handover as an unreliable system. The interview studies revealed a clear understanding as to the pressures of work on both players in the handover however, even with this knowledge the quality of the handover was still put in jeopardy due to inadequate time given to the process.

1.2.7.4 Structured interviews & surveys

Surveys can be utilised to effectively gain an insight as to the prevalence of emergent themes from interview studies. Staff from four emergency departments and one paramedic department (n=80, 68% response rate) were surveyed as to their opinion on the content and their current frustrations with handover. This method of data collection enabled the quantification of opinion on the core information points required for a safe handover: reason for attendance; history of events; problems requiring immediate intervention; treatment carried out since onset; any significant/relevant medical history (125). They found paramedic dissatisfaction with the handover process*: 'The nurse is too busy looking for a bed to listen.'* As well as nursing staff frustration *'At times, information is given which is non-essential and not relevant to the ongoing care of the patient.'* The interviewees were asked to supply a list of essential information points for handover which influenced the design of a computerised system to aid patient handover. They also recommended that information should be given in two tranches, with essential information handed over immediately with follow up information provided once the receiving parties were ready to receive it.

Another survey performed in ED to quantify the opinions on the paramedic to hospital handover found the patients' condition influenced the satisfaction of the process. They administered a survey to paramedics (n=67, 61%) and medical (n=30, 64%) hospital staff at one hospital (126). They found that most ambulance crews felt that the medics gave their undivided attention in 24% of occasions however despite this, 72% felt they were generally given enough time to handover (126). 35% of receiving doctors felt that reports were well structured.

The quality of junior doctor shift change handover was evaluated in a pre/post-quality improvement intervention study by asking the incoming team to record the incidence of

surprises on their shift (56). They evaluated these care events in two categories - whether the event could have been anticipated or not. This allowed estimation of what percentage of post-handover surprises could potentially be impacted by improving the quality of the handover process. They found that between 77 and 83% of surprises could have been anticipated and therefore covered in the handover (56).

1.2.7.4.1 Summary

The use of surveys permits the researchers to focus interviewees upon specific issues. In the studies above, interviewees were asked about their frustrations with handover and through this, quantifiable issues were demonstrated both within the paramedic and nursing community.

1.2.8 Different tribes: doctors and nurses

Modern healthcare relies upon collaborative working between multiple separate professions (127). These professions bring with them embedded assumptions, language and perspectives which breed misunderstanding and conflict (128) with resultant impact on patient morbidity and mortality (3, 129). It is estimated interdisciplinary miscommunications contribute to 61% of medical error which is thought to be due to the shift from individual to team-based working (130). Tribal differences have been long acknowledged, and indeed feared as a potential source of conflict of the NHS *'there is far too much 'tribalism' in the NHS for its own good*' (131). Deep-seated differences are long standing between the nursing medical profession, at least partly due to the historical difference in class, gender and selection (131).

1.2.8.1 Interconnection of work

A theory of 'knotworking' has proposed that each individual involved in delivering care always leaves chinks or imperfections in their care but effective inter-disciplinary working

reduces the gaps in the care (132). This model fits within the dynamic description of the perpetuation and prevention of error as proposed by Reason, with error originating within a complex system of work (1).

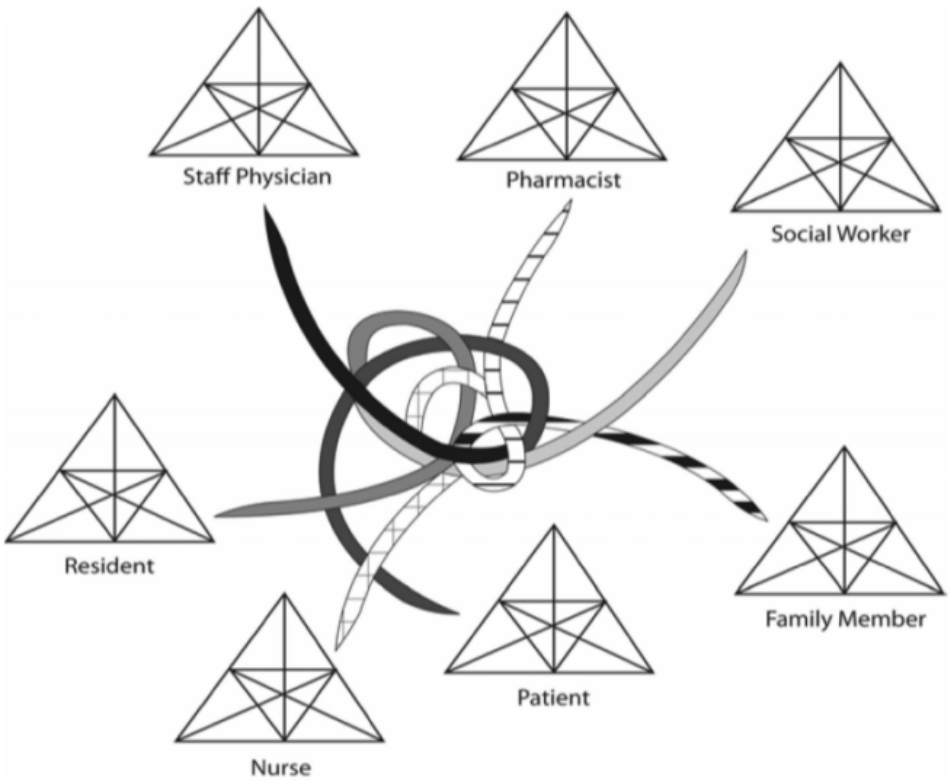

Figure 12 'Knotworking' knot, where each collaborator in the healthcare team is represented by an activity system and thread of activity (132)

1.2.8.2 Tensions between nursing and medical communities

Tension between medical and nursing methods begins early and is perpetuated throughout training; these tensions at worst can lead to tribal 'warfare' (127, 133). Nurses are trained and maintained within a strict hierarchy and quickly know their place within the structure (134). They tend to be law setters and followers, unlikely to deviate from accepted protocols. Doctors, however, tend to be maverick and undertake non-standardised

practice, with frequent rule-breaking not being frowned upon by their colleagues as long as the outcome was favourable (135). The sentiment of these findings was summed up in a personal reflection which stated that:

'Doctors were superior. They had the hard knowledge that made ill people better. The nurses, usually women, were good but not necessarily very knowledgeable. They were in charge of folding pillow cases and mopping brows.' (136, 137).

The inter-disciplinary differences were noted in an early ethnographic study which concluded the relationships were akin to a game, and if poorly played could result in warfare (137). It was thought that in this game, the nursing staff had the upper hand due to their indoctrination into it early in their training. Doctors, by contrast, were frequently only introduced to the complexities of interdisciplinary working once they had qualified. It was noted that how a doctor responded to an opportunity to make use of the nurses' knowledge of a patient would impact upon future interactions. If the doctor responded positively, they could benefit from a mutually rewarding relationship and enhanced efficiency. If, however the doctor failed to pick upon these subtle cues, they were seen as someone to be tolerated, and if, most unwisely, they took the cues as an insult to their knowledge and practice, all-out warfare between the parties commenced 'a rocky road' (137). Warfare can come in different guises – both active hostility but more passive aggression, exemplified by strict work to rule e.g. not taking telephone prescriptions. The complexities of inter-professional working were observed in an ethnographic study of intensive care. Conflict was noted when nursing recommendations were not adhered to by the medical staff (138). The nurse in the scenario was noted not to directly contradict the medical staff or challenge their knowledge but there were frequent occurrences of medical staff doubting nursing knowledge (138). With regards to conflict resolution, a more recent Norwegian study found that healthcare professionals tended to avoid conflict and if that

failed, attempt to force change and then negotiate (139). It was thought that avoidance was most frequently used in order to keep the peace but also not to harm the aggrieved parties' long-term career prospects. Forcing an issue reinforced the power balance, was seen as efficient and was less risky. Negotiation however was seen to be more risky and time consuming as there was no guaranteed outcome (139).

Nursing staff, particularly district nursing staff, are more open to collaborative working than their GP or practice nurse colleagues. Upon analysing 400 general practitioner (GP) and district nurses respondents, inter-professional differences were revealed, with GPs less likely to support multidisciplinary working than district nurses (140). This finding has been seen in other international studies, with healthcare managers more closely associating themselves with nursing rather than medical staff. A survey of over 3000 medical, nursing and managerial professionals found significant differences between professional groups on the grounds of financial realism and transparent accountability, with doctors more likely to identify with individuality of clinical work than their nursing or managerial colleagues (141).

Inter-professional relationships are complex and are influenced by both inter-personal relational factors as well as external organisational influences (142). All relationships require some level of trust in order for interaction or transactions to occur. The process of forming a trusting relationship has been defined in an organisational level as:

'… trust in the goodwill of other parties is a cumulative product of repeated past interactions among parties through which they come to know themselves and evolve a common understanding of mutual commitments.' (143)

It is conceivable that the relationships which are forged between two organisations i.e. macro-level relationships, will mirror those on the micro-level and so learning from one system can be transferred to another. Trust in practice is thought to be formed in two main

ways: calculus and identification-based trust (142). Calculus-based trust is formed when parties act in a consistent fashion and deliver on promises they have set. It is thought that the motivation to complete the task is the worry of retribution rather than the receiving of a reward (144). The other category of trust, identification, is formed once relationships have permitted a sharing of ideas and mutual goals, permitting one member to act on the other's behalf (144). It is felt that one type of trust may be significantly superior to the other, with identification trust (built on direct knowledge of competence and openness) being seen as resilient and longer lasting (145). It has been thought that these models of trust are parallel to one seen in the working practices of doctors and nurses and indeed have been noted in qualitative studies of the subject (142). This study proposed a chain of events from a demonstration of professional competence to mutual respect and eventually to trust (142).

1.2.8.3 Handover differences

Handover-related difference between nurses and doctors can be seen in their communication habits. Doctors value succinct, fact-orientated oral communication whereas nurses communicate through written formal documentation(146). These differences can result in tension when professional groups are working in parallel, however it is conceivable that on the rare occasions where doctors and nurses have to report to each other these tensions could be greater. This unusual inter-professional working event most frequently occurs at health gaps such as transfer of a patient to accident and emergency; handover of a patient from theatre to recovery or intensive care (22, 117); shared care between midwives and obstetricians (147) and general practitioners and community nurses (140).

The quality of inter-professional working has been shown to have a direct effect on patient outcomes following ITU treatment and total hip replacement (148). This latter study

investigated the role of an inter-professional relationship intervention in total hip replacement (THR) patients vs total knee replacement (TKR) patients (control). They introduced a 30 minute morning formalised meetings in designated rooms which was found to significantly reduce length of stay in their active THR group(from a mean of 4.1 days (SD 2.1) to 2.7 days (SD 1.4), $p < 0.05$) (148).

The incidence of iatrogenic harm was studied within intensive care by asking frontline staff to record instances of error alongside an observation of task activity by independent technicians. Following a four month observation period, it was found that 37% of communication between nurses and physicians were found to contain errors. It was felt that this was surprising given that inter-disciplinary verbal communication accounted for only 2% of the total activity (149). Another study in four intensive care units in the United States set to explore the complexities of interdisciplinary working by surveying 230 nurses and 90 physicians (representing a 53% response rate) using an intensive care adaptation of the aviation safety attitudes questionnaire (150). They found that only 33% of nursing staff rated the collaboration with physicians to be high or very high. This was in stark contrast with physicians, with 73% feeling their collaboration with nurses to be high or very high (150). The authors felt that the discrepancy might be due to lack of encouragement to speak up; poor disagreement resolution and lack of involvement in decision making.

The transfer of patients from theatre to recovery or intensive care has been investigated both in paediatric (151-153) and adult care (117, 154-156). Unlike other areas of healthcare provision where adult and paediatric services are different due to reasons of understanding and capacity, the post-operative handover requires complete reliance on the healthcare staff to give an accurate account of all patients due to medically-induced incapacity.

The post-operative handover has many aspects which can be interrogated due to the reliance on technology, complexity of the tasks, people involved in the procedures. The

assessment of human-to-human interaction has focused on the information exchanged as well as the tasks performed (151, 153, 155). Evaluation has also been performed on the human-machine interface, with assessments as to the impact of healthcare devices upon the handover process. The post-operative handover process is generally performed within the recovery ward. It is intended that this environment is peaceful, comfortable and calm (157). The reality of this ideal was assessed and it was found that the handover was frequently disturbed by other patients, healthcare professionals, healthcare-specific and generic equipment (155).

These assessments universally revealed the potential for information omission and corruption at a crucial patient transfer event (151, 156).

1.2.9 Interventions

As handover relies upon the smooth and safe running of a complex system, interventions have been generated to attempt to reduce the impact of handover-generated error upon patient care. These interventions which were undertaken within a hospital environment have been systematically analysed (158), with the findings of this investigation formally presented in the following chapter, however in the following section, I will utilise the SEIPS model to frame the design, implementation and reported results of handover improvement interventions (103).

1.2.9.1 Person focused interventions

Humans are never fully compliant with rules and deviation from accepted procedures occur in every industrial system (159). Violations have been classified in three categories of legal, illegal-normal and illegal-illegal as illustrated: (Figure 13) (159). The relevance of this model is often illustrated by describing the speeding habits of drivers on motorways, with most drivers admitting they break the 70mph speed limit (illegal-normal) however most are

shocked at the thought of someone going over 100mph (illegal-illegal). This model demonstrates the pressures which human beings frequently operate under with their actions being influenced by their cultural background, the expectation of others, technology and the organisation in which they work.

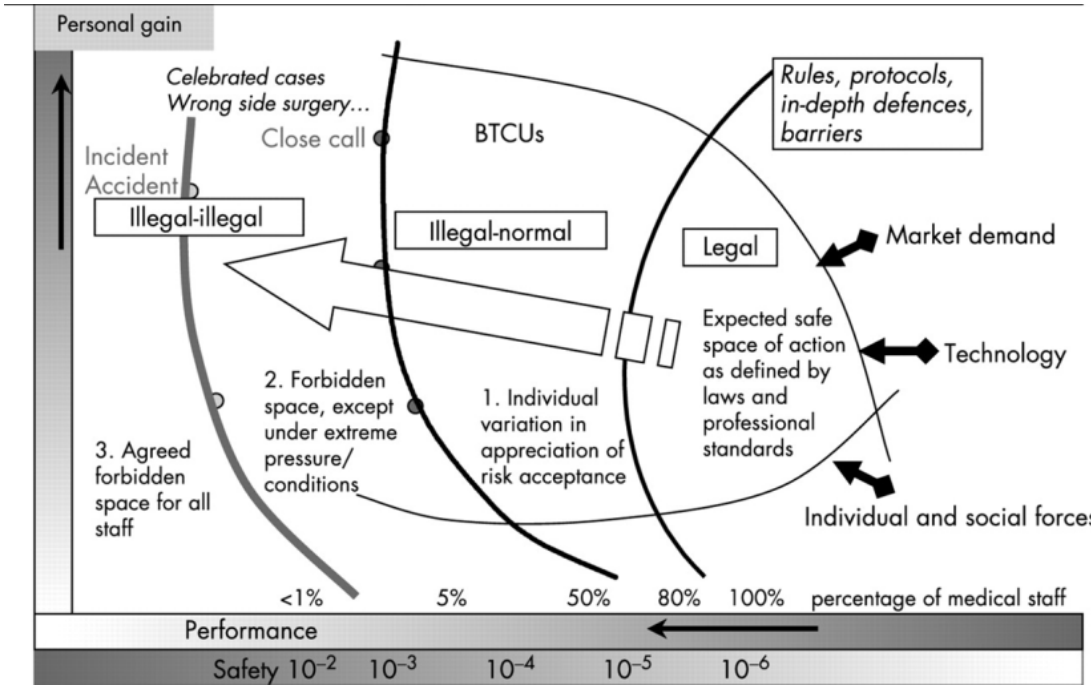

Figure 13 Model displaying human propensity to commit violations of protocol (159) Borderline Tolerated Conditions of Use (BTCUs)

The pace and complexity of modern healthcare systems requires adaptability of the frontline staff who routinely forge 'work arounds' or indeed 'violate' protocols or guidelines in order to deliver safe healthcare. 'Work arounds' are generated by workers to bypass what are seen as unnecessary or impractical procedures to reach the required goal (160). These are often hidden from management and can have a detrimental long-term effect if they hide deficiencies or bypass safety checks, however they can have a positive effect of added system resilience (160). Violations are often performed by healthcare staff.

These may be known or unknown. In a recent estimate the number of mandated steps in caring for an acute patient with a neck of femur fracture stood at 75 (161). It is perhaps unsurprising that frontline healthcare staff who have to manage a wide range of complex conditions are unable to follow guidance which is published by more than one regulatory body (In 2011 Carthey et al. estimated there were 21 UK organisations publishing anaesthesia guidelines) (161).

It is notoriously difficult to quantify the contribution that violations make to error. One study analysing the root causes of incidents revealed that violations (defined as: deliberate disregard of rule or protocol) of prescribed rules accounted for 4.8% of adverse events (162).

It may be that some deviation from the accepted protocol are beneficial for the wider health system as often, the healthcare system is poorly understood and ill-prepared that staff have no option other than committing violations. An interview study of anaesthetists reported likelihood of committing violations in the operating theatre reinforced the relevance of the BTCU (Borderline Tolerated Conditions of Use) model, with most anaesthetists reporting they would regularly deviate from national safety guidelines, with a few saying they would regularly commit more serious violations (163). The authors found that most of the violations were performed by staff who were unaware that their actions could be classed as violations. This suggests that perception of risk and patient safety needs to be heightened to prevent violations as well as to withstand pressure from peers (163). These violations are often confined to the local proximity of microsystems. The microsystem (those directly caring for a patient) is most vulnerable to the effects of error and near-misses (164). These microsystems do not behave like an automated manufacturing line, and therefore the introduction of a new rule or protocol needs to take local customs and culture into consideration in order to increase the likelihood of uptake.

In order for overall system outcomes to improve, each individual microsystem has to reduce its component error (165).

1.2.9.1.1 Mnemonics

In handover, a number of human-focused interventions have been created to attempt to standardise communication. A large number of mnemonics have been produced with an attempt to improve the standardisation and reliability at handover. In one systematic review, 24 mnemonics were described, each tailored for a specific handover need (68). The most frequently utilised mnemonic in this review (32/46 articles, 70%) was SBAR (Situation, Background, Assessment and Recommendation). SBAR was developed in an American hospital in 2002 in response to a miscommunication between a laboratory and ward over a warfarin prescription (166). This mnemonic has since been successfully transferred internationally and is frequently utilised in UK hospitals. The evidence base supporting the use of this and other mnemonic framework is scanty, with the majority of reports relying upon anecdotal evidence of quality improvement (68).

1.2.9.1.2 Training in handover

Other attempts have focused on the role of medical education on handover improvement. A survey of UK medical schools found that the majority did not routinely include handover in the official curriculum, with half stating that students received ward-based exposure (167). It has recently been estimated that formal undergraduate handover education, either verbal or written, ranged between 23 and 30% of UK medical schools (168). The attitude of 'on the job' training has been recognised as inappropriate for such a crucial, safety critical task, with specific importance being placed on team working and professional responsibility (167). The low prevalence of medical school education is in sharp contrast to the views of recent medical graduates. Training on handover was ranked third in overall importance with 83% of all 20,484 participants selecting it as a key need (169). The

importance of handover teaching was supported by UK consensus (170). An interview study of junior and senior doctors further delineated the importance for practising clinicians as illustrated below (171):

Dr1: 'Getting taught how to receive a handover as well and what to do with the information, particularly when you've been referred a patient and then you get told what to do with them and you know, I've heard people complain of this, and they go and see a patient on somebody else's ward and they say this is what you need to do with them and then …' (171)

A systematic review on handover education interventions found that there was a lack of evidence supporting handover education interventions, with none showing a positive impact on patient safety (172). Most studies demonstrated effect change within a simulated environment, however only 1/10 demonstrated learning transfer to the workplace (Kirkpatrick level 3) (172, 173). Variation was found in the studies as to the core learning outcomes as there was no national standard for handover curricula (172). They found that the training programmes drew inspiration from other parallel fields of work including NASA, aviation Crew Resource Management (CRM) and Formula 1 motor racing. These authors concluded that existing training programmes had not sufficiently demonstrated their efficacy in improving handover. They subsequently developed an educational intervention which aimed to target the three outcomes of information transfer; responsibility and accountability and systems to facilitate handover (174).

In the 2012 annual General Medical Council (GMC) survey of post-graduate doctors in training, shift handover practices were found to be an area of concern (175). The survey revealed mixed practices, with nearly a quarter of shift handovers either not occurring or happening in an informal manner (Figure 14) (175). This figure changed little in 2013

Figure 3: Handover arrangements before night duty (n=40,178) and after night duty (n=40,902)

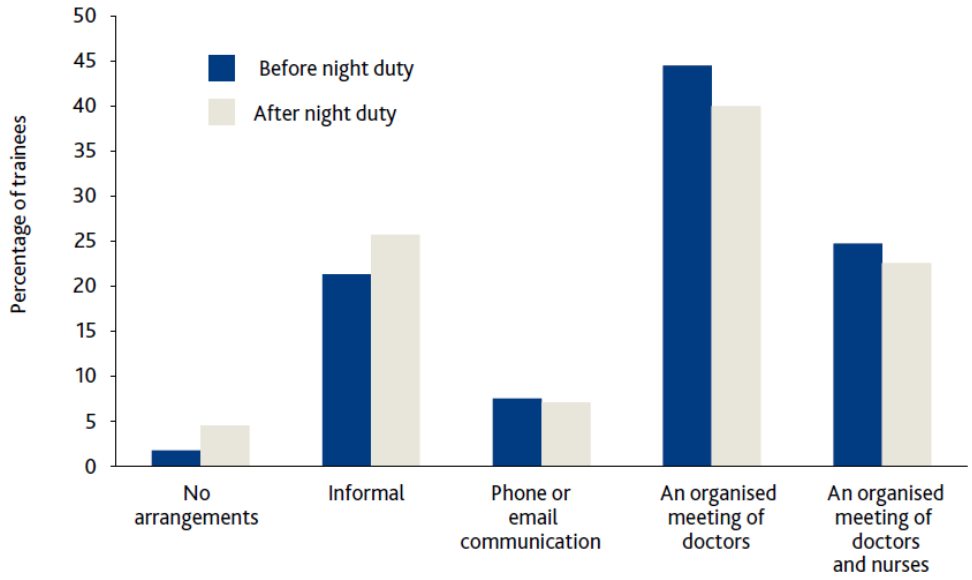

Figure 14 GMC survey 2012 (175)

1.2.9.2 Technology and tools- focused interventions

It has been recognised that patient handover could be augmented with technological interventions. These range from the relatively simple introduction of a text document or spreadsheet which records inpatient name and location, to hospital-wide patient management software. It is intended that these interventions should reduce the cost of investigation duplication, the risk of polypharmacy and conflicting plans of care (72). These interventions, both at the low and high cost ends of the spectrum, have received support – for example from the UK Royal College of Physicians releasing an example of a handover document (176) to the now abandoned 'NHS Connecting for Health' national computerisation of all healthcare records (177). The 'NHS Connecting for Health' programme aimed to produce a seamless interface throughout the UK, permitting safe

transfer of care between providers. However, the project was abandoned due to an unprecedentedly large overspend of £12bn (178).

In addition to the financial implications, poorly introduced healthcare IT systems can result in additional patient harm. Concerns were raised early in the introduction of electronic medical records, in that disconnect between the patient transfer and documentation may result in errors in care:

'With the deployment of the EMR, future admission procedures might reasonably be expected to dispense with the handover of paper: Ward nurses will be able to access the information recorded at A&E directly through the nurses' station EMR terminal. While this may seem to exemplify the ways in which the EMR can streamline and improve information - handling procedures, we suggest that, inasmuch as this will decouple the arrival of patient and patient information, it may undermine the robustness and reliability of the process' (179).

At one healthcare institution, a Computerized Physician Order Entry (CPOE) system was introduced. The aim of the system was to ease the requesting and monitoring of patient investigations. Patient mortality was monitored prior to and post introduction of the system and a significant increase in mortality was noted as a direct consequence of the IT package introduction(odds ratio: 3.28; 95% confidence interval: 1.94–5.55) (180) (Figure 15). The authors of this paper felt that the dramatic increase in mortality was secondary to the impact of the computer system on pre-existing patterns of work, with the usual *"chain of events"* being negatively impacted from patient admission through to discharge (180). Impact was seen particularly on high-intensity work periods such as admission and acute resuscitation of patients with shared and transferred care changing from a face-to-face episode to a human-computer-human interface, thus negatively impacting upon team working and instantaneous delivery of care (180, 181).

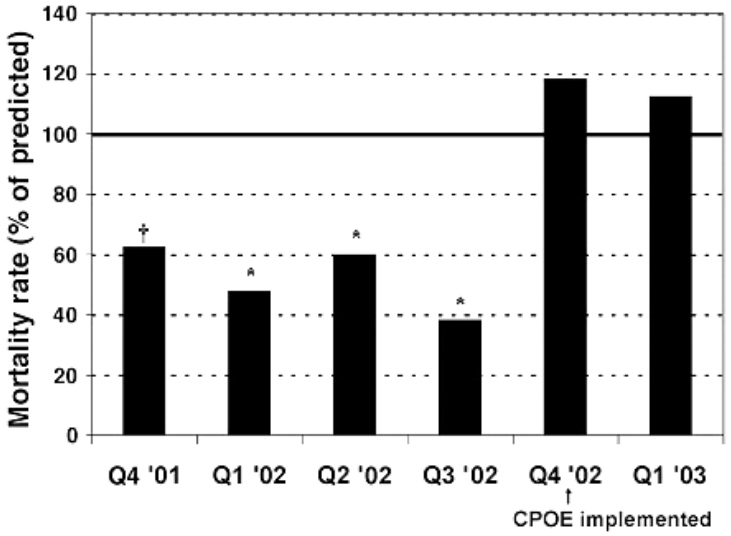

Figure 15 Observed mortality rates (presented as a normalized % of predicted mortality) during the 18-month study period are plotted according to quarter of year (180)

1.2.9.3 Environmentally focused interventions

The environment in which handover occurs can influence the effectiveness of the outcome. A number of handover interventions have sought to improve the reliability of the handover process through modulating the environment in which it is carried out. A collaboration between patient safety researchers and designers focused upon creating design-led interventions to reduce healthcare error in five key processes (hand hygiene, infection control, medication, vital signs and handover) (182). One of the projects surrounded the alteration of the staff room to function as a rest space as well as a purpose built handover room (182).

1.2.9.4 Task focused interventions

The transfer of patients is often combined with the task of providing on-going care. These handovers tend to be the most critical for the care of the acutely unwell or potentially

unstable patients including admissions to the emergency department, intensive care or high dependency units, and the post-operative handover. On these occasions, patients are often unable to communicate with their healthcare providers, have non-invasive or invasive monitoring attached and may be receiving ongoing treatment (e.g. cardiopulmonary resuscitation, continuation of intravenous drug therapy) (77, 117, 151, 155). Interview studies of paramedics confirmed that their patient handover was often frustrated with receiving nurses distracted by multiple competing tasks and priorities:

'Nurses are multi tasked so they are trying to do 4 or 5 things at once so they are not being overtly attentive, or not listening at all, or are continuously interrupting your train of thought by getting you to move the patient across or do this or do that and then getting you to restart the handover again.' (Paramedic 10, Site 1) (77).

The concept and practice of multitasking is pervasive in healthcare. Acknowledgement of this underpins the introduction of the concept of the *'sterile cockpit'* with the WHO surgical safety checklist – a concept that helps to systematically reduce the frequency of communication being layered with task performance (183). In brief, the WHO surgical safety checklist aims to introduce standardised checks for all theatre-based procedures. The purpose of the checklist is multimodal and includes: theatre team orientation; enforced safety checks of the patient; prompts to provide medical interventions such as antibiotics. Multitasking adds to the cognitive load of the operative and has been shown to increase the chance of healthcare error (184, 185). It is thought that the particular reasoning behind the impact upon patient safety is the reduction in the capacity of the working memory and swamping attentional resource (186-188).

In an attempt to relieve some of the operative burden on the healthcare providers, interventions have been created to separate task from the verbal or written handover (151, 155).

1.2.9.5 Organisation focused interventions

At the beginning of the 1990s, radical changes were introduced to the working patterns and training regimes of UK doctors. The previously unregulated working hours began to be curtailed in response to a number of well publicised untoward incidents in the UK and the USA where it was concluded that the root cause of fatal mistakes was the level of exhaustion in the doctor in charge (189-191).

The long working hours of the medical profession were known, if not acknowledged, to be a threat to patient safety. 41% of surveyed American Anaesthetists admitted to exhaustion-related error (192, 193). The wide dissemination in the mass media of exhaustion-related medical error research resulted in national public movements for the reform of medical training and a reduction in the working hours of doctors. Investigators found a direct correlation between long working days and serious medical errors, with one study finding 36% more complications in a 24 hour shift pattern vs short shift pattern (136.0 vs. 100.1 per 1000 patient-days, $P<0.001$) (194). The traditional 100+ hour working week was reduced initially to 80 hours in the USA, and in the UK 78 hours to 56 hours and then 48 hours (secondary to the European Working Time Directive (195)). The introduction of the legislation resulted in the increase in the number of shift handovers (54) as well as the fear of reduction of training opportunities for doctors in training (196, 197).

A colloquium of surgeons performed a thought experiment prior to the introduction of the limitation of junior doctors' working hours and referenced a number of potential benefits and threats associated with its introduction (198). The main threats listed by this body surrounded the concerns of professionalism and increasing work for senior doctors alongside the limitation of training opportunities, however the inherent introduction of more handovers was not recognised as a threat (198). The effect of additional handovers as

a consequence of shift working has been noted and thought to be detrimental to patient care if sufficient time is not allocated to implement appropriate safeguards (199).

Unfortunately, the reduction in working hours has not been a panacea for medical error (200). A systematic review analysing the effect of reducing junior doctors' working hours on levels of patient safety concluded that there was insufficient evidence to support an overtly positive impact (201). Another study found a non-statistically significant difference between pre and post-introduction of the American working time directive, with mortality decreasing by 0.25% (202). These findings contradict public and professional opinion, which broadly supports the hypothesis that the reduction of total working hours will reduce total harm, potentially due to the lack of awareness of the perils of handover (201). There have been reports in the medical literature of harm as a direct consequence of increasing frequency of handover (203). A link has been shown between discontinuity in patient care and higher rates of complications as well as financial costs. Specifically, delays in requesting investigations increased (204); the rates of adverse events increased by 14% when patients were cared for by cross-covering physicians (95); the cost of care increased due to the repetition of investigations (205).

1.3 Introduction conclusion

The delivery of safe modern healthcare requires suitably well-engineered transitions of care. Findings from the literature indicate that the majority of the transitions have been left to develop organically, rather than being intentionally designed for optimal ease and safety (54). Uncertainty remains as to the optimal approach for handover despite numerous interview and survey studies as well as observational work. Important differences exist between doctors and nurses which make co-working more challenging.

The study of handover has benefited from research approaches originating in a wide range of disciplines. This has resulted in a broad coverage of the subject with a variety of

approaches including: financial outcomes, patient and staff satisfaction, error capture (near misses, adverse events and mortality) and length of stay. The diverse research methodologies employed does produce challenges when attempting to collate findings to produce more generalizable results. By evaluating the current state of research in handover, specifically the role of quality improvement interventions, it is hoped that some previously unseen core truths could be revealed.

The post-operative handover is one which brings particular challenges to those involved. It is one of the few occasions within healthcare which relies upon good inter-professional working. At the point of transition, the patient is unable to rectify incorrect or missing information and is generally a passive actor in the process due to the effect of the anaesthetic. The responsibility for the smooth transition lays solely in the hands of those involved, most commonly the anaesthetist and the recovery nurse. From previous work on the subject, the stresses relating to inter-professional working may be greater than thought (117). To explore this, as well as the post-operative handover in general, a semi-structured interview study was designed to reveal inter-professional differences.

An area of work which is frequently overlooked within the evaluation of handover is the quality of transferred information. Handovers from a link in the chain of the course of patient care, however all too often they are viewed in isolation. Some researchers have investigated the handover in context, either through evaluating pre-handover documentation (156) or whether the handover prepared the oncoming staff adequately by anticipating all on shift activities (56). The importance of this should not be underestimated, as it may be that previous works, by evaluating the handover in isolation, were crediting handovers with greater success than their accuracy warranted. Transitions in care can no longer be left to chance and require investigation and systematic, evidence-based improvement.

Therefore, the aim of the research discussed in the remainder of this MD thesis is to first examine the evidence of quality improvement interventions in clinical areas comparable with the post-operative handover; to interview stakeholder members of staff about their experiences and recommendations for the post-operative handover and to apply these findings in a process improvement intervention in the post-operative handover.

2 Interventions employed to improve intra-hospital handover: a systematic review

2.1 Introduction

Recognition of the potential risks of handover errors has led many researchers to attempt to improve it using a range of methods, both simple and multi-component. Interventions generally target information transfer directly, individual behaviour or the wider system. Approaches have included process standardisation: training and education; changes to the physical environment; use of technology; explicit signalling of accountability transfer; and others (103). The diversity of methods used to evaluate the results has been even greater, but can be grouped as dealing with patient outcome, staff satisfaction, compliance with protocols, time taken and information transfer.

Uncertainty remains as to the most effective method for improving intra-hospital handover. This systematic review aims to evaluate interventions which have been developed to improve the quality and/ or safety of the intra-hospital handover process with a view to enabling hospital practitioners and researchers focus on refining the most effective interventions.

2.2 Methods

2.2.1 Systematic review question, inclusion and exclusion criteria

The PICO (Problem/Patient/Population, Intervention/Indicator, Comparison, Outcome) question on which our search strategy was based was: in intra-hospital handovers do systematic interventions compared with no interventions improve outcomes (Table 1).

Table 1 PICO question, systematic review

POPULATION	INTERVENTION	COMPARISON	OUTCOME
groups of clinical staff handing over information about patients under their care	systematic intentional interventions	no intervention	patient outcome, staff satisfaction, time taken or information transfer

Inclusion criteria for studies comprised:

a) includes an intervention developed with the intent of improving handover quality and/or safety
b) set within an intra-hospital environment
c) uses both pre- and post-intervention assessment to evaluate improvements
d) assesses any of: knowledge and skills of staff, staff behavioural change or patient outcomes.

The protocol was registered with an international database of prospectively registered systematic reviews: PROSPERO (an international database of prospectively registered systematic reviews in health and social care, welfare, public health, education, crime, justice, and international development) (registration number: CRD42012001995).

2.2.2 Search strategy

The following online databases were searched for papers published in English (due to logistics involved in translation) between January 2002 and July 2012: EMBASE, MEDLINE, HMIC and CINAHL. The search was limited to 10 years' worth of data as it was thought

unlikely that any pertinent publication would have been published prior to 2002 due to a lack of research interest in the area. Synonyms of handover, inter-hospital and intervention were constructed, and produced the following result:

- handover(s), hand over(s), hand-over(s), handoff(s), hand off(s), sign out(s), sign off(s), shift to shift (s), inter shift(s)
- patient transfer(s), intrahospital transfer(s), intra hospital transfer(s), intrahospital transport(s), intra hospital transport(s)
- intervention(s), improve(wild-card Boolean for improvement/improvements/improving etc.), quality, safety, strateg(wild-card Boolean for strategy/strategies/strategic etc.), training, instrument(s), standardi(wild-card Boolean for standardisation/standardization/standardisations etc.), mnemonic(s)

2.2.3 Data extraction

The returned studies were de-duplicated and abstracts were reviewed by one reviewer for compliance with inclusion criteria. References and the grey literature were not formally searched. An initial search of the grey literature was undertaken prior to the commencement of the systematic review however data from these publications were found to fall short of the requirements for inclusion. The remaining full text articles were independently reviewed by two reviewers in consultation with a third. One reviewer (Eleanor Robertson) assessed all of the included papers; the other two reviewers reviewed half of the included papers (Lauren Morgan, Human Factors researcher and Sarah Bird, 4th year medical student). Data were extracted independently onto collection forms and the reviewers then met and compared responses. If there were differences of opinion, they were resolved by mutual agreement and if this was not reached, an external opinion was sought (PM).

Where available, the following information was extracted from each paper: number of hospitals; medical speciality; type and number of handovers; study design and timeline. The interventions were categorised in three over-arching-categories of 'information', 'person' and 'wider system'. The 'information' intervention category included: Standard Operating Procedures (SOP/protocol); minimum dataset (including checklists) and mnemonics. The 'person' category comprised: teamwork training (TwT) classroom; TwT coaching; video-reflexive techniques and medical supervision. The wider system category contained two components: Information Technology (IT) and Continuous Process Improvement (CPI). This framework was created to enable comparison between similar interventions. It is based both the SEIPS (Systems Engineering In Patient Safety) and 3D model of patient safety, but adapted to handover which requires transfer of information, by people in the context of a wider healthcare system (103, 206).

We classified the outcomes into five categories: measures of information transfer (information transfer, error, forgotten tasks); measures of satisfaction with the process (staff and patient); measures of compliance with the pre-specified protocol for the handover (observation of handover, use of intervention, legibility, tasks during handover, completion and team performance); handover duration (handover length, time to treatment and overtime requirements) and outcomes (adverse events (AE) and patient outcomes). It was thought that data would not be suitable for meta-analysis due to the heterogeneity of both study design and collection methods. Where available, data would be harvested from the included papers.

2.2.4 Quality assessment

Assessment of the quality of included papers was undertaken using a modified Downs and Black checklist (207). This quality assessment tool has 27 questions covering three sections of: reporting, external validity, internal validity (bias and confounding). It has previously

been adapted for use with handover studies (94). We were keen to utilise as much of the original checklist as possible. Some of the original questions were excluded as they were either deemed to be unsuitable (Q5, Q9, Q11, Q14, Q17, Q25 and Q26) (Table 2) or required adaption (Q4, Q8 and Q21).

Table 2 Excluded Downs and Black questions

Downs and Black question	Reason for exclusion
5. Are the distribution of principal confounders in each group of subjects to be compared clearly described	Not pertinent for handover
9. Have the characteristics of patients lost to follow-up been described?	Loss of follow-up would not be an outcome measure in handover
11. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?	Patients are rarely consented
14. Was an attempt made to blind study subjects to the intervention they have received?	It was thought that it would be highly unlikely that a study could be created where the participants of the intervention could be 'blinded' to the intervention
17. In trails and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcomes the same for cases and controls?	Not relevant for handover studies
25. Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?	'Confounders' in handover not defined
26. Were losses of patients to follow-up taken into account?	Most handover studies are not framed around a single patient rather a handover

We adopted an abbreviated modification of a recognised guideline to evaluate intervention transferability. Subsequent to the undertaking of this systematic review, a more appropriate assessment of reporting quality more pertinent to that of quality improvement

interventions has been published (208). Had this been available at the time of the systematic review it would have been selected in preference of the Downs and Black checklist. The Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines were developed in 2009 to promote standardised reporting of healthcare quality improvement interventions (209). For the purposes of this review, Q8, Q9a, Q9b, Q9c, Q14a, Q16b and Q16c were used to critique the included papers on the reporting of their intervention. We also recorded whether there was a specific mention of the SQUIRE guidelines

2.3 Results

2.3.1 Summary

A total of 29 studies were identified for inclusion in this review. The search of EMBASE, MEDLINE, HMIC and CINAHL provided a total of 631 citations and following de-duplication, 437 papers remained (Figure 16). Of these, 329 were excluded after abstract review as not matching the inclusion criteria. The full text of the 108 remaining citations was reviewed in more detail. 79 of these did not meet the inclusion criteria and were excluded. The remaining 29 papers met the inclusion criteria (Figure 16) and (Table 3).

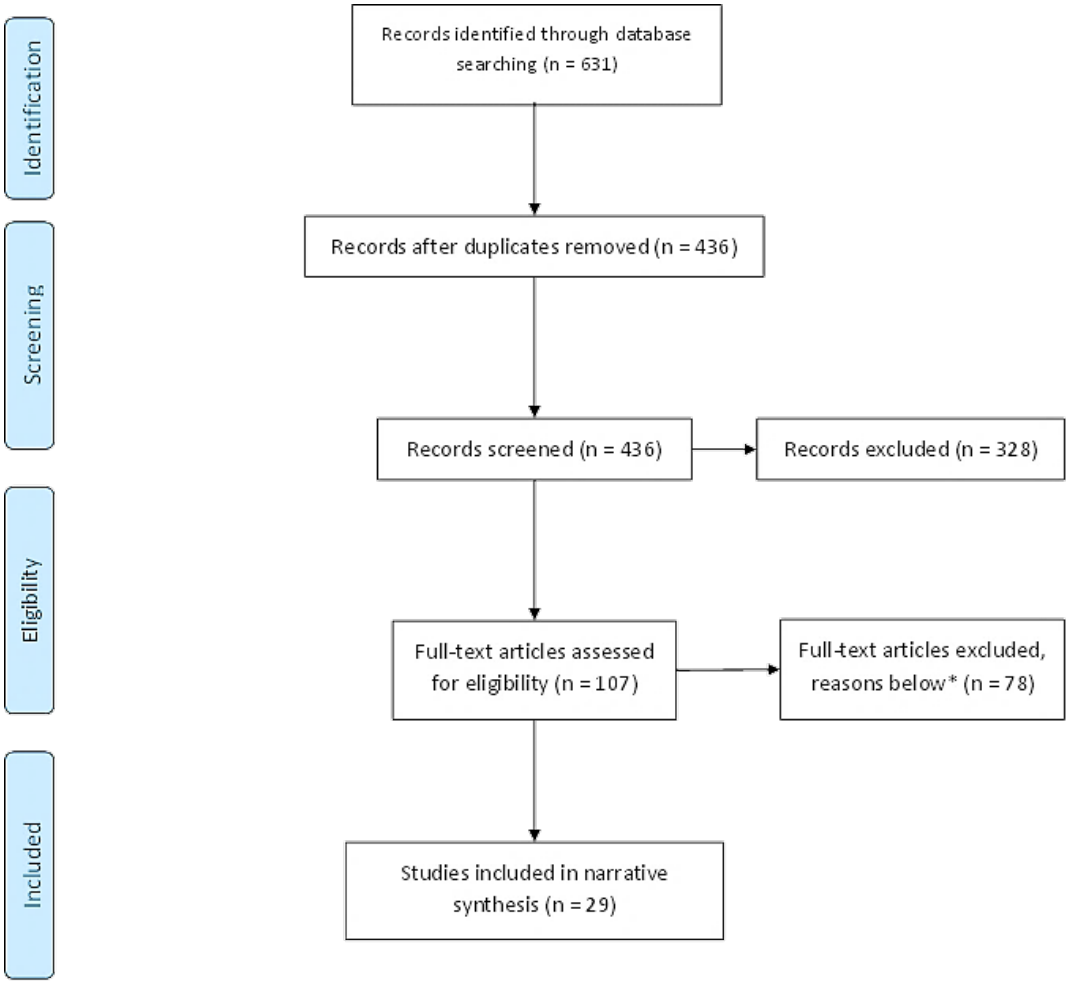

Figure 16 PRISMA diagram for assessment of studies in the systematic review

*Reasons for exclusion round 2: thesis 1; review 8; non-handover 2; non-interventional 5; no data 7; multi-targeted interventions (more than just handover) 1; comment 4; insufficient outcome measures as per-inclusion criteria 50.

Table 3 Included studies characteristics

First author / Year / (Reference)	Study design	Handovers (n)	Ward environment(s)	Type of handover	Staff involved	Interventions
Catchpole 2007 (151)	Pre & post uncontrolled	50	Paediatric ICU	Theatre to recovery/ICU	Nurses, Junior and Senior Doctors, Surgeons and Anaesthetists	SOP/Protocol; TwT coaching
Street 2011 (210)	Pre & post uncontrolled	5	-	Shift change	Patients and Nurses	Mnemonic
Van Eaton 2010 (211)	RCT	-	Medical & surgical ward	Shift change	Nurses, Junior and Senior Doctors, Surgeons	IT
Alem 2008 (212)	Pre & post uncontrolled	24	A&E	Shift change	Senior Doctors	TwT coaching; minimum dataset
Klee 2012 (213)	Pre & post uncontrolled	-	Intensive care	Shift change	Nurses	SOP/Protocol; minimum dataset; CPI
Palma 2011 (214)	Pre & post uncontrolled	-	Intensive care	Shift change	Nurses, Junior and Senior Doctors	IT
Wilson 2011 (215)	Pre & post uncontrolled	161	A&E	Shift change	Patients, Nurses, Other (relatives)	Mnemonic

Ellul 2011 (216)	Pre & post uncontrolled	-	Surgical ward	Shift change	Junior and Senior Doctors	SOP/Protocol
Hindmarsh 2012 (217)	PDCA cycles	76	Medical ward	Ward to ward	Nurses	SOP/Protocol; mnemonic
Pesanka 2009 (218)	Pre & post uncontrolled	-	Medical & surgical ward	Ward to ward	Patients, Nurses, Senior Doctors, Anaesthetists, other (porters)	Minimum dataset
Salerno 2009 (219)	Pre & post uncontrolled	-	Medical ward	Shift change	Junior and Senior Doctors, Other (management)	IT
Ferran 2008 (220)	Pre & post uncontrolled	103	Surgical ward	Shift change	Junior Doctors	Minimum dataset
Bernstein 2010 (221)	Pre & post uncontrolled	-	Whole hospital	Shift change	Nurse, Junior and Senior Doctors	IT
Anderson 2010 (222)	Pre & post uncontrolled	963	-	Shift change	Junior and Senior Doctors	IT
Rudiger-Sturchler 2010 (223)	Pre & post uncontrolled	1011	A&E	Shift change	Junior and Senior Doctors, Other (chief ED physicians)	Mnemonic; minimum dataset

Telem 2011 (224)	Pre & post controlled	-	Surgical ward	-	Junior Doctors	TwT classroom
Agarwal 2012 (225)	Pre & post uncontrolled	1078	Paediatric ICU	Shift change	Nurses, Surgeons, Anaesthetists	SOP/Protocol; minimum dataset
Horwitz 2009 (226)	Pre & post uncontrolled	3634	Medical ward	Ward to ward	Junior and Senior Doctors	SOP/Protocol; IT
Gakhar 2010(227)	Pre & post uncontrolled	161	Whole hospital	Shift change	Junior Doctors	Mnemonic; IT; TwT classroom
Berkenstadt 2008 (228)	Pre & post uncontrolled	390	Intensive care	Shift change	Nurses	TwT coaching; minimum dataset; video reflexive
Joy 2011 (153)	Pre & post uncontrolled	79	Intensive care	Theatre to recovery/ICU	Nurses, Surgeons, Anaesthetists	SOP/Protocol; TwT classroom
Petrovic 2012 (229)	Pre & post uncontrolled	60	Intensive care	Theatre to recovery/ICU	Nurses, Surgeons, Anaesthetists, Other (management)	SOP/Protocol; TwT coaching; TwT classroom
Bump 2012 (230)	RCT	224 (95 active)	Medical ward	Shift change	Junior and Senior Doctors	Mnemonic; minimum dataset; TwT classroom; medical supervision

Ryan 2011 (231)	Pre & post uncontrolled	135	Surgical ward	Shift change	Junior Doctors	IT
Zavalkoff 2011 (152)	Pre & post uncontrolled	31	Paediatric ICU	Theatre to recovery/ICU	Nurses, Junior and Senior Doctors, Anaesthetists, Surgeons	Minimum dataset
Thompson 2011 (232)	Pre & post uncontrolled	-	-	Shift change	Junior Doctors	Mnemonic
Dankers 2010 (233)	Pre & post uncontrolled	-	Medical ward	Shift change	Junior Doctors	SOP/Protocol; IT; TwT classroom
Coutsouvelis 2010 (234)	Pre & post uncontrolled	52	Oncology	Ward to ward	Nurses, Junior Doctors, Other (pharmacist)	SOP/Protocol; mnemonic; minimum dataset
Craig 2011 (235)	Pre & post uncontrolled	43	Paediatric ICU	Theatre to recovery/ICU	Nurses, Junior and Senior Doctors, Surgeons, Anaesthetists	SOP/Protocol

Table 4 Studies intervention, outcome measures and quality checklist results

Reference	Intervention	Outcome measure	Quality checklist	
	No. of components (type of components *)	No. of outcome measures (type†)	D&B	SQUIRE
(151)	2 (a, b)	5 (C1, teamwork; I2, O2, T1)	14	2
(210)	1 (c)	3 (C2, S1, T1)	1	0
(211)	1 (d)	2 (I3, O1)	12	1
(212)	2 (e, b)	3 (C1, I1, S2)	9	5
(213)	3 (a, e, f)	3 (S1, T1, T3)	9	5
(214)	1 (d)	2 (C2, S1)	9	4
(215)	1 (c)	4 (C1, O1, S1, S2)	5	3
(216)	1 (a)	2 (C3, I1)	7	3
(217)	1 (a, c)	3 (C2, I1, O1)	10	5
(218)	1 (e)	2 (O1, S2)	9	4
(219)	1 (d)	3 (I3, S1, T1)	9	4
(220)	1 (e)	1 (I1)	11	2

(221)	1 (d)	3 (C2, I1, S1)	9	2
(222)	1 (d)	2 ((I1, S1)	6	3
(223)	1 (c, e)	4 (C1, I1, S1, T1)	11	4
(224)	1 (h)	3 (I2, O1, S1)	9	5
(225)	2 (a, e)	2 (O2, S1)	15	5
(226)	2 (a, d)	2 (O2, S1)	7	5
(227)	3 (c, d, h)	4 (C1, I1, I2, S1)	10	6
(228)	3 (b, e, g)	3 (C1, C4, I1)	12	4
(153)	2 (a, h)	4 (C1, I1, S1, T1)	13	5
(229)	3 (a, b, h)	1 (C1)	10	4
(230)	4 (c, e, h, i)	1 (I1)	17	6
(231)	1 (d)	2 (O2, T2)	14	6
(152)	1 (e)	3 (I1, O1, T1)	14	5
(232)	1 (c)	3 (I1, S1, T1)	6	6

(233)	2 (a, d, h)	3 (I1, O1, S1)	6	2
(234)	3 (a, c, e)	2 (I1, T2)	8	6
(235)	1 (a)	4 (C1, I1, S1, T1)	11	6

* a – SOP/Protocol; b – TwT coaching; c – mnemonic; d – IT; e – minimum dataset; f – CPI; g – video reflexive; h – TwT classroom; i – medical supervision

† I (Information transfer): I1 – Information transfer, I2 – error, I3 – forgotten tasks;

S (Satisfaction): S1 – Staff satisfaction, S2 – patient satisfaction;

T (Time): T1 – Handover length, T2 – time to treatment, T3 – overtime requirements;

O (Outcomes): O1- adverse events, O2 – patient outcomes; C (Compliance):

C1 – observational, C2 – use of intervention, C3 – legibility, C4 – tasks during, C5 – completion.

2.3.2 Study design

The study designs of the included studies included: 2 randomised control trials (211, 230); 1 pre-/post-intervention controlled trial (224); 25 pre-/post-intervention uncontrolled trials (151-153, 210, 212-216, 218-223, 225-229, 231-235) and 1 Plan-Do-Check-Act (PDCA) design (217) (for summary see: APPENDIX A, Table 21,).

2.3.3 Study duration

A total of 11,759 handovers were included in studies which gave this information, with a median of 103 handovers per study. 10 studies (211, 213, 214, 216, 218, 219, 221, 224, 232, 233) gave no information on the number of handovers they included.

Of those studies which gave information on the length of time for each study component the median length of time (days) for pre-intervention data collection was 28 (range 4-224), for intervention 28 (range 1-252), the gap between intervention and the commencement of post-intervention data collection was 10.5 (range 0-365) and the post-intervention data collection period was 28 (range 4-224). Seven studies gave no information on any component of their study design timeline (151, 152, 210, 218, 222, 225, 235) and 14 gave no information on one or more study timeline components (153, 211, 212, 215-217, 219, 221, 224, 226-228, 231, 233) (Table 5)

Table 5 Study design timeline: median, min, max and Inter-quartile range (IQR)

	Median, days	Range (min-max) days	IQR [0.25,0.75] days	No information provided
Pre-intervention	28	4 - 224	[8.75,52.5]	n=13 (151-153, 210, 215, 218, 221, 222, 225, 227, 228, 233, 235)
Intervention	28	1 - 252	[7,98]	n=16 (151, 152, 210, 212, 215-222, 224-228, 235)
Delay pre-intervention	10.5	0 - 365	[0,77]	n=16 (151-153, 210, 211, 215-220, 222, 224, 225, 233, 235)
Post-intervention	28	4 - 224	[15,39]	n=11 (151-153, 210, 218, 222, 225, 227, 228, 233, 235)

2.3.4 Study environment

The majority of the studies (22) were performed in one ward environment. Four studies were performed in more than one environment (211, 218, 221, 227) and three gave no detail on the study environment (210, 222, 232)

Table 6 Study demographics: ward environment and handover type

		Shift change n=19	Ward-to-ward n=4	Theatre to recovery/ ICU n=5	Unknown n=1
1 ward	Accident & Emergency (A&E) n=3 (212, 215, 223)	n=3 (212, 215, 223)	-	-	-
	Intensive care (ICU) & High Dependency (HDU) n=5 (153, 213, 214, 228, 229)	n=3 (213, 214, 228)	-	n=2 (153, 229)	-
	Paediatric ICU n=4 (151, 152, 225, 235)	n=1 (225)	-	n=3 (151, 152, 235)	-
	Medical ward(s) n=5 (217, 219, 226, 230, 233)	n=3 (219, 230, 233)	n=2 (217, 226)	-	-
	Surgical ward(s) n=4 (216, 220, 224, 231)	n=3 (216, 220, 231)	-	-	n=1 (224)
	Oncology n=1 (234)	-	n=1 (234)	-	-
>2 wards	2 wards (medical & surgical ward(s)) n=2 (211, 218)	n=1 (211)	n=1 (218)	-	-
	Whole hospital n=2 (221, 227)	n=2 (221, 227)	-	-	-
Unknown	Unknown n=3 (210, 222, 232)	n=3 (210, 222, 232)	-	-	-

2.3.5 Improvement strategies

The included studies took varied approaches to handover improvements. 15 studies were mono-component interventions (152, 210, 211, 214-216, 218-222, 224, 231, 232, 235) and the remainder contained two or more components. 7 studies shared an intervention component, 2 interventions used the SIGNOUT mnemonic (227, 230) and 5 used the SBAR (situation, background, assessment and recommendation) mnemonic in its original (210, 217, 218, 224) or slightly adapted format (232). The components of interventions are described below alongside what type of environment they were utilised in (Table 7):

Table 7 Comparison of handover type vs. intervention focus[1]

		Shift change (n=19, 65.5%)	Ward-to-ward (n=4, 13.7%)	Theatre to recovery/ ICU (n=5, 17.2%)	Unknown (n=1, 3.4%)
Information (56.8%)	Minimum dataset (n=10)	n=7 (212, 213, 218, 220, 225, 228, 230)	n=2 (218, 234)	n=1 (152)	-
	Mnemonic (n=8)	n=6 (210, 215, 223, 227, 230, 232)	n=2 (217, 234)	-	-
	SOP/ Protocol (n=11)	n=4 (213, 216, 225, 233)	n=3 (218, 226, 234)	n=4 (151, 153, 229, 235)	-
Person (23.5%)	Medical supervision (n=1)	n=1 (230)	-	-	-
	TwT classroom (n=7)	n=4 (227, 228, 230, 233)	-	n=2 (153, 229)	n=1 (224)
	TwT coaching (n=3)	n=1 (212)	-	n=2 (151, 229)	-
	Video-reflexive (n=1)	n=1 (228)	-	-	-
System (19.6%)	CPI (n=1)	n=1 (213)	-	-	-
	IT (n=9)	n=8 (211, 214, 219, 221, 222, 227, 231, 233)	n=1 (226)	-	-

[1] SOP: Standard Operating Procedure; TwT: teamwork training; CPI: Continual Process Improvement; IT: Information Technology; ITU: Intensive Care Unit

A summary of the intervention components used across all the included studies can be found: (Figure 17).

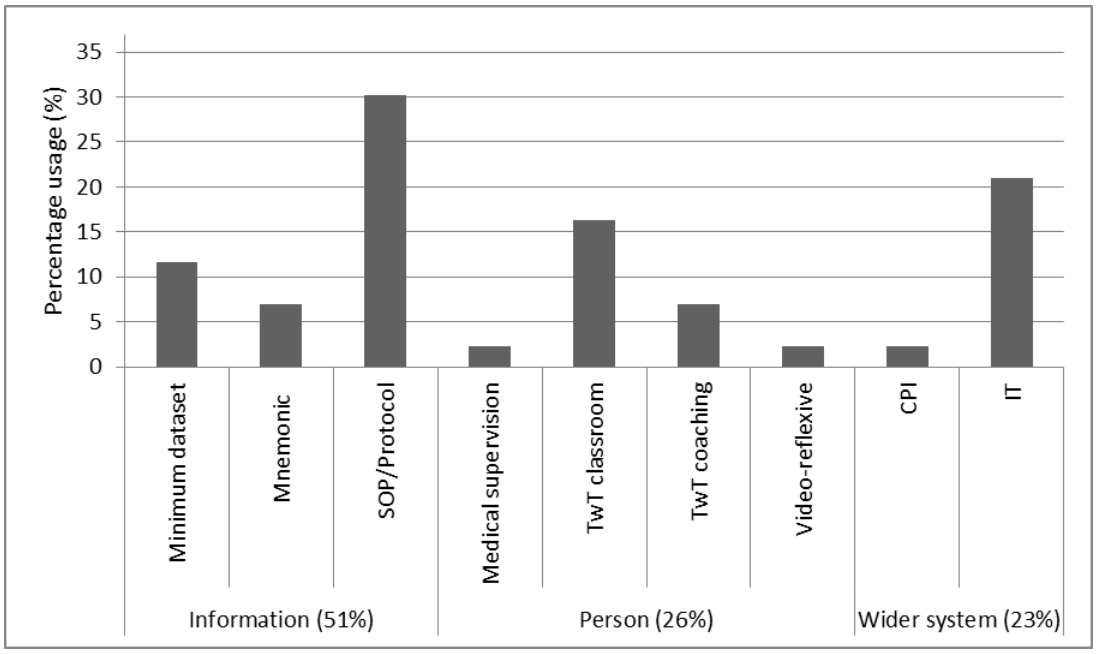

Figure 17 Handover improvement interventions

2.3.6 Outcome in non-randomised studies

The studies evaluated their interventions using a total of 82 discrete outcome measures, each study using between one and five measures (median of three). Two studies evaluated their interventions with two outcome measures (216, 218); Seven used three (210-214, 217); One study used four (215) and one used five outcome measures (151). There were no primary outcome measures in common among all the studies.

The studies are presented in Table 21 in (Appendix A) by type of intervention - information, person or wider system - and if a study contained a component from more than one category, the study is represented twice.

19 studies reported a statistically significant change in at least one of their outcome measures (152, 153, 219-223, 225-230, 232-235), whilst 10 did not (151, 210-218). Improvements in information transfer were the most commonly reported successes, being found in more than half of the studies examining this (152, 153, 220, 222, 223, 227-230, 232-234), and staff satisfaction was the next most commonly improved in 35% of studies (153, 219, 221, 222, 225-227, 229, 232, 233, 235) – a similar proportion to those reporting improvements in time taken and compliance with protocols. Of studies which attempted to evaluate changes in patient outcome, only 2 (225, 231) of 10 (151, 211, 215, 217, 218, 224-226, 231, 233) studies reported a significant benefit with one study reporting a 12% decrease in adverse events (need for CPR (cardiopulmonary resuscitation), ECMO (extracorporeal membrane oxygenation) and acidosis)(p=<0.001) (225) and the other study reporting a significant reduction in length of stay from five to four days (p=0.047) (231). There was no obvious difference between the success rates of multi and mono-component interventions, and none of our defined categories (standardisation tools, team training approaches or quality improvement programmes) seemed to be clearly associated with a better chance of a positive outcome.

2.3.6.1 Outcome in randomised controlled trials

There were two RCTs (randomised controlled trials) in the study selection, and these are considered separately. One (211) focused on the use of a computerised reporting system to speed up handover, and found that it achieved this aim without apparently increasing the risks of adverse events or care errors. The method of randomisation was poorly described and the concealment of treatment allocation was not clear. Although the senior assessor who judged whether clinical errors had occurred was blinded to treatment group, the data supplied to this clinician apparently came from the residents under study and was therefore unblinded, resulting in a high risk of bias. The other RCT (230) evaluated the

benefit of supervisor feedback on handover performance amongst internal medicine residents, but suffered from similar defects in randomisation and blinding of assessors. This study reported significant improvement in compliance with the protocol but also suffered from a high risk of bias.

2.3.6.2 Modified Downs and Black checklist

The quality score of the included studies according to the modified Downs and Black (D&B) checklist ranged from 1 to 17, with the median score of 9, IQ[7.5,12] (modified max score 20)(Table 4). There was no statistical difference in the median D&B score of positive and negative studies (Mann-Whitney U Test p=0.248) (Table 8).

2.3.7 SQUIRE guidelines

No studies reported the use of the SQUIRE guidelines, despite 24 of the 29 studies being published after 2008 (the date when the guidelines were published). No studies scored the maximum adapted score of 7. The modified SQUIRE guideline score ranged from 0-6 and the median score was 4 (IQR:3,5) (Table 4).The median modified SQUIRE score of negative studies was 3.5 and for positive studies it was 5 (Mann-Whitney test p=0.047).

Table 8 Modified Downs and Black scores for significant and non-significant studies

		Modified D&B sub-section				Total (max 20)
		Reporting	External validity	Internal validity	Confounding	
Statistically significant	Median	4.5	1	1.5	1	9
	Minimum	1	0	0	0	1
	Maximum	8	2	4	2	14
Not statistical significant	Median	6	1	3	1	10
	Minimum	3	0	0	0	6
	Maximum	8	2	5	4	17

2.4 Discussion

2.4.1 Findings in context

This review was embarked upon from the viewpoint that handover is important, frequently the focus for improvement studies and difficult to characterise (211).

Failures in handover can produce a wide variety of untoward outcomes ranging from lack of event awareness, to loss of significance of information points, and to dropping or lacking

information required to perform tasks (78, 236). In medicine, the serious consequences which can ensue are well recognised, as is the disparate and unsatisfactory nature of handover processes in many settings. This explains the large number of studies devoted to improving handover processes. Unfortunately, this review shows that the heterogeneous nature and poor quality of most studies leaves us unable to draw many firm conclusions about how handover may be optimised. It was found that the large majority of published studies are small, uncontrolled, un-blinded before/after comparisons, and often with a short or undefined follow-up period.

The only outcome category which was apparently improved in more than 50% of studies which looked at it was information transfer. Time taken for the process, compliance with protocol and staff satisfaction all improved in a minority of studies, while clinical outcome improvements were reported in only two of 10 studies. This does not exclude the possibility that the positive findings in some of these studies were valid, but the lack of strong trends and the poor study designs mean that we cannot have much confidence in this. At present, it appears that information transfer is the aspect of handover in which interventions most readily show change: whether this results in any beneficial outcomes beyond better recording of data is however unclear.

2.4.2 Information transfer

It seems rational to use information transfer as a key outcome measure for evaluating handover since reliable transfer of information is the principal purpose of formal handover. However, it needs to be carefully considered what in particular should be known about information transfer in order to measure it effectively. It is suggested that the functional value of a handover session can be effectively measured by evaluating three aspects of information transfer—completeness, accuracy and organisation. The last of these is essential to ensure that the most important data are not obscured by other items and are

easy to identify because the information is presented in a structured way. However, we recognise that other taxonomies for describing information transfer may also be valid, for example, that proposed by Patterson and Wears (82) or by Pezzolesi et al (66), and that ultimately empirical trials will determine whether our suggestion proves the most useful.

2.4.3 The need for a taxonomy

Another major problem identified by the review is the lack of any common language or taxonomy for describing or classifying handovers, improvement methods or types of outcome. Other fields of study have found this a major handicap to progress (236) and we therefore recommend that attempts are made to harmonise terminology and definitions. This would greatly assist others trying to repeat the work. However, the problem is the great heterogeneity of handover settings and types which exist in healthcare.

To develop a taxonomy which can adequately describe all of these is challenging, and arguably to consider them all together as we have done may be inappropriate, depending on the question posed. If an agreed taxonomy existed, it would have helped us to make more sense of the literature by allowing us to identify whether there were subgroups where the literature findings allowed us to hypothesise (and the data available would allow no more than this) that certain intervention types were particularly valuable.

It is nevertheless suggested that handovers themselves require a template for describing them which covers setting, personnel, means of information transfer, standardisation of procedure, feedback and summarisation, task allocation and recording. This review has used a four-category classification to divide the approaches to improvement reported in the studies we found, but feel further improvements to this could be made.

However, for the present we recommend the classification of outcomes into measures of staff satisfaction, information transfer, protocol compliance and clinical outcome. Not only

did this deal with all the papers in the current study in a satisfactory manner, but it lends itself readily to analysis of the data using the Kirkpatrick four level evaluation model for training and educational interventions (173).

2.4.4 Need for improved study design and reporting standards

The evidence we found in this review has to be regarded as very unreliable because the studies were of poor design and therefore susceptible to bias from multiple sources. This was reflected in the low scores on the modified D&B scale used (207). Secular trends may give a false impression of improvement caused by interventions; observers may find it very difficult to avoid bias in assessing subjective endpoints; and short follow-up periods can give an unrealistic impression of impact if they capture a fleeting improvement in performance which quickly fades. The two randomised studies (211, 230) should be less susceptible to bias but their unusual design, the lack of clinically relevant endpoints and the lack of true blinding decrease their internal validity significantly. Generally speaking, the transferability of the studies in this review was also low, as reflected in the scoring using the SQUIRE (Standards for Quality Improvement Reporting Excellence) guidelines (209).

2.4.5 Limitations

The limitations of our own study were partly a consequence of the problems of the literature we studied. A more comprehensive search not restricted by language, date range or a search of the 'grey literature' might have yielded further studies, but it seems unlikely that this would have improved the overall quality or reduced the heterogeneity of the studies. The inclusion of 'grey literature' in particular has been shown to increase both the complexity and time required to a systematic review, however it does also increase the representation of studies with neutral or negative outcomes, thus reducing the impact of publishing bias (237, 238).

An example of heterogeneity in study design was the duration of the study periods, which varied by a factor of at least 50 for each component of the study. These two aspects of the literature, heterogeneity and poor quality, were the principal causes of our inability to reach strong conclusions. Our initial hypothesis was very broad, and perhaps we might have achieved more insights into the literature had we focused on a smaller and less heterogeneous subgroup of handover types. Any such restriction would of course have affected the applicability of our findings.

It was thought important to assess the quality of study design and reporting in these studies, since the generally poor level of scientific rigour in these areas is such an important contributor to the difficulty in reaching definitive conclusions from this literature at present. As no wholly suitable assessment method existed at the time of evaluation, modified SQUIRE and D&B checklists were used to study transferability and validity, respectively (207, 209). The modifications were designed to allow evaluation of an enormously heterogeneous and often poorly described group of studies. Several questions in both checklists were not appropriate for evaluation of studies of handover of the types included in our search, either because they were entirely irrelevant or because they were partially irrelevant and attempting to answer them would increase rather than decrease uncertainty in the evaluation of the studies. It is recognise that the truncated evaluations we used have not been fully validated, but we feel the logic used in producing them means that they are more likely to be both valid and discriminatory than the use of the full versions of the tools involved. Further work could verify this hypothesis; at present, we have to accept that our quality and transferability assessments should be considered with caution. Since undertaking the review, the TIDieR reporting checklist has been introduced and widely accepted as the benchmark for reporting quality improvement interventions by most journals (208). It is envisaged that this standard will improve the quality of research reporting.

2.4.6 Recommendations

We recommend that future studies agree on a core common assessment method. It may be that an assessment of information transfer would be suitable candidate as we have shown it to be sensitive in numerous studies. This would enable future meta-analysis of the effect of potentially costly interventions. We would also recommend an agreed standardised gap between the completion of the intervention and the commencement of post-intervention assessment. It is recommended that some form of information transfer assessment would need to be included in this method, but that consideration should be given to including an outcome from each of the four categories we identified. Future interventional trials should follow the SQUIRE reporting guidelines (209) which would enable future researcher and clinicians to repeat their findings and the dissemination of improved safety processes between institutions (239).

The findings from this study will be utilised to inform the creation and implementation of an improvement intervention in the post-operative handover. It is intended that the systematic review would enable both the selection of appropriate outcome measures but also enable the selection of previously successful quality improvement methodologies from allied environments.

3 Semi-structured interview study of theatre and recovery staff exploring the post-operative handover

3.1 Study aims

The safety and efficiency of the post-operative handover impacts upon care following the operation and can bear upon the patient's post-operative morbidity and mortality (148, 225). The post-operative handover is unusual as it requires coordination and cooperation between healthcare professionals from different backgrounds within a changeable and potentially distracting environment.

The post-operative handover has been scrutinised in the past, both in the context of observing working practice (117, 151, 153, 240) and interview studies (123). The researchers found that there were elements of unsatisfactory practice and that conflict frequently bubbled under the surface between the professional groups. It was felt that sufficient uncertainty remained as to how each professional group viewed both a good and poor post-operative handover. It was thought that the key participants would also be best placed to comment upon how the process could be improved.

This interview study aims to examine the opinions of the key players in this handover namely: recovery nurses, anaesthetists and surgeons. It was constructed to explore inter-professional differences in the post-operative handover process. This was based upon the theory of tribal differences between nurses and doctors and how that this might be revealed during an inter-professional handover. The handover was considered in the following ways:

a) the definition of a good and a bad handover
b) what information should be handed over
c) what ground rules should be set for handover

3.2 Methods

3.2.1 Interview method

Due to the previous body of work on handover a semi-structured framework was selected. This interview style would permit the examination of handover in a sufficient depth whilst ensuring clarity and focus of interviews and permit inter-disciplinary comparison. The interviews were undertaken in a standardised format with clear, open questions which permit the interviewees to comment widely on a subject.

One of the most relevant studies (123), evaluated the post-operative handover process in general surgery using group interview techniques. It was thought that this technique would not result in the required granularity of information and also risked a groupthink effect, thereby dampening intra- and inter-professional differences (241).

3.2.1.1 Question generation

The study was designed to draw on the interviewee's own experiences in the care of patients in the post-operative period. Questions were generated using Patton's framework,

namely open questions which draw on the interviewee's behaviour or experience; opinion or belief; feelings; knowledge and background (242). The interviewees were asked questions in increasing complexity, moving from one of behaviours and experiences to one of opinions. It was thought that this would help to ease the interviewees into the interview process and increase the accuracy of their responses (242).

The questions were written by ER to explore: extremes of behaviour (good and bad handover) as well as establishing core components of handover, namely: which team members should be involved, what should be handed over and what ground rules should be established to maintain quality.

The interviewees were asked to draw on their past experiences in handover in healthcare, both within their current hospital and in their previous places of work. This focus on the wider experience was thought to be important to aid the transferability of the interview study. Following this, they would be asked to design a good handover, considering both the information content and the context in which the handover took place. These practising professionals have 'real life' experience in which to ground their opinions. It was thought that the interviewees should be given opportunity to talk specifically about both the content of the verbal handover and the surrounding circumstance of the handover (ground rules). It was thought necessary to ask about the rules of the handover as it was anticipated that the interviewees would find it relatively natural to comment on the information points, however they may unintentionally omit to comment on the surrounding infrastructure of the process.

In order to attempt to provide practical groundings of the interviewee's recommendations, it was thought to be important to apply some form of limit on the information point to be handed over. It is accepted that there is a limit on the number of verbal information points that someone is able to retain (243). Using the guidance of the 7 +/- theory (244), the

interviewees were asked, following producing their list of guidance, how many information points they thought they could remember following handover. It was thought that this question would result in a self-created insight into the limits of the human memory and could aid in the self-rationalisation of the list of information points for the handover.

The questions were formed in an iterative process, with peer-review by Dr Lauren Morgan (Human Factors researcher), Prof Sharon Mickan (evidence-based medicine), Mrs Julia Matthews (researcher and Operating Department Practitioner) and Ms Laura Bleakley (Human Factors researcher) as well as the real-life testing as a pilot with a recovery nurse at the test site. The interview schedule can be viewed in APPENDIX B

3.2.2 Study logistics

3.2.2.1 Site

The interview study was performed at a specialist orthopaedic tertiary referral centre in Oxfordshire. The hospital had five wards, one combined recovery and high dependency unit (HDU), six operating theatres and an outpatient suite, with a total of 106 beds (245). This site was chosen as the researcher was already undertaking observational/interventional research in the operating theatres as part of an NIHR-funded study. The theatre and recovery staff gave consent for observation of work as well as partaking in interview studies. Due to the close nature of the observational work, the researcher (ER) had an opportunity to gain the trust of the theatre and recovery staff which was thought to enable more effective interviewing conditions. Although the hospital was a specialist centre, it was thought that lessons learnt from this site could be made relevant to other locations, especially as the anaesthetists and surgeons regularly undertook work in other hospitals in the vicinity.

The site delivers both primary and revision orthopaedic and plastic surgical procedures to adult patients with degenerative, traumatic and neoplastic pathologies. The majority of the operation were elective (90%). The hospital also provided pharmacological and non-pharmacological, non-surgical therapeutic treatments.

A total of 1073 staff were employed at the hospital site as of 2013 including 268 nursing, 115 medical and 169 allied therapy staff. There were a total of 24 consultant orthopaedic surgeons and 4 consultant plastic surgeons. The consultant anaesthetists were seconded to this hospital by another larger local teaching hospital with approximately 30 consultant anaesthetists regularly providing anaesthetic cover for the operating lists.

3.2.2.2 Type of staff recruited

Initial informal observations of the post-operative handover revealed that the core post-operative handover team consisted of an anaesthetist (usually a consultant or senior registrar) and a recovery nurse. It was considered that as the overall responsibility for the patient remains with the responsible consultant surgeon it was pertinent to interview them to capture their opinions on the process and their perceived role.

3.2.2.3 Sampling procedure

Recruitment occurred from one hospital site, the Nuffield Orthopaedic Centre NHS Trust which has an international reputation for the care of patients with complex orthopaedic and plastic surgical complaints. This hospital management and staff were participating in a multi-site, stepped wedge controlled study investigating the role of quality improvement interventions in surgery, the Safer Delivery of Surgical Services Study (S3) (246). The hospital had therefore already entered into an agreement to have work practices observed and permit their staff to participate in interview studies.

The interviewer had worked in the hospital for a year prior to the commencement of this research and as such had pre-existing relationships with the theatre staff. It was thought that this pre-existing relationship would aid recruitment to the interview study. Through developing a collegiate-type relationship, it was thought that the interviewees might more readily consent to be interviewed during their working day. The main drawbacks could include if relationships were not in a healthy state the interviewees might not feel in a position to withdraw from or contribute to the study.

Recovery nurses, surgeons and anaesthetists were personally invited to participate in the interview study in a convenience sample (247). The convenience sampling technique was employed within the study, with the slight caveat that to provide homogeneity between the groups, some limited exclusion criteria were applied relating to grade and length of employment. Due to the tight working schedules, the nurse manager and lead anaesthetist were approached prior to recruitment. There was no equivalent 'lead' surgeon to approach, so surgeons were approached on an individual basis. The lead anaesthetist and nurse manager agreed to the interview study and the nurse manager recommended particular staff members for the interview. In order to prevent the feeling of coercion and to ensure the nurses freely consented to be interviewed, I approached each of these nurses when the nursing manager was not present and asked whether they would agree to be interviewed. All of the nurses I approached agreed. The nursing manager kindly allocated time within their shift to be interviewed.

Consultant anaesthetists and surgeons were recruited on an ad-hoc basis which was appropriate to the work environment in which the interviews were being performed. The participants were informed as to the nature of the interview study along with the likely length of the process. No one who was approached declined to participate.

3.2.2.4 Level of experience

The inclusion criteria were that doctors should be consultant surgeons or anaesthetists and the nurses should be registered. This requirement was a proxy for environmental stability. The majority of junior medical grades rotate through multiple hospitals and may not have spent sufficient time at the interview site to fully appreciate the current system of work. It was thought that by requesting fully trained members of staff, they would have reached a state of stability in their working practice within the organisation and therefore be in a better place to comment on working patterns. It was also noted that there was a difference in availability of trainees in anaesthetics as opposed to surgery, making an increased likelihood of bias if there was representation of junior grades within one discipline than another. To ensure that there was a commonality between the groups interviewed, the staff had to have been employed at the hospital for more than a year.

3.2.3 Conduct of interview

All interviews were undertaken by one interviewer (ER) on the hospital site. In order to fit around the interviewee's work schedule, the timings of the interviews were often set in a flexible manner, with the expectation that the interview would be taken during a convenient break in their working day. The interviews were carried out in a quiet area within the hospital, with the majority of the interviews occurring within the theatre suite which further increased the convenience of the interviews for the interviewees. The interviewees consented to the recording of the interviews.

Interviews were recorded on a digital voice recorder (Olympus AS-2400). The MP3 files were then downloaded on to transcription software (Olympus DSS Player Standard - Transcription Module). All of the interviews were transcribed by one person (ER) on to Microsoft Word 2010. These transcriptions were then analysed utilising Microsoft Excel and Word 2010 and SPSS v20. These programmes were selected as the researcher, ER, was

familiar with the intricacies of the packages and it was felt impractical to utilise a more bespoke package due to lack of experience and time limitation. This finding is not unusual in the field as some researchers have previously noted (248).

3.2.4 Qualitative data analysis

Analysis was based on grounded theory; a systematic approach to analysis based on inductive theory (249). This approach was chosen as grounded theory allows for the 'drawing out' of theory or themes from the data rather than analysis based on a pre-conceived framework, as the theory is then embedded and created within its environment (250). However, in retrospect (further elaborated in the discussion) grounded theory was not the optimal technique for this study. This is due to the volume of pre-existing knowledge. In hindsight it would have been more fruitful to analyse the interviews using framework analysis.

Interviewees were briefed as to the intention of the interview. It was explained that the interview would likely last for between 30 mins to 1 hour. Interviews were recorded using a digital Dictaphone. ER transcribed the interviews. Using an inductive approach to analysis ER read, reviewed and explored each interview to generate open codes. An external researcher to the study (Miss Lorna Flynn) also reviewed a subset of the interviews independently and generated codes, which were then compared with those created by ER, allowing for verification. These codes were then further explored and refined, creating broader, overarching themes from the data. Some example themes identified include the pressure of time, interruptions and distractions, markers of a good and bad handover.

ER transcribed all of the interviews, and by doing so, afforded another opportunity to review and become immersed within the interview and note emergent themes. The transcribed interviews were reviewed, with common themes noted and explored in other interviews for similarities and differences. Pertinent quotes were recoded to give greater

granularity to the analysis. The analysis was primarily performed within each interview question. Once completed, the interview was reviewed in the round, with overarching themes being created to reflect this.

3.2.5 Ethics

Ethics Committee approval was obtained for this study (Oxford A REC 09/H0604/39). Hospital management and all theatre staff were fully informed of the study and gave written, informed consent to take part during the observation period.

3.3 Results

3.3.1 Sample characteristics

A total of 25 interviews took place between 7th December 2011 and 24th February 2012. 10 recovery nurses, 7 consultant anaesthetists and 8 consultant surgeons were interviewed (Table 9). The interviewees worked in the hospital for a mean of 10.5 years (anaesthetists 12.7 years, recovery nurses 12.0 years and surgeons 5.9 years). The interviews occurred at pre-arranged time during working hours in a private room within the theatre complex so interviews could occur between clinical activities.

Table 9 Interviewee characteristics

Role	Sex	Interview date	Years in current role in hospital
Consultant Anaesthetist	M	07.12.11	20
	M	15.12.11	20
	M	25.01.12	20
	M	31.01.12	10
	M	02.02.12	5
	M	06.02.12	1.5
	M	08.02.12	19
	F	15.02.12	5.5
Recovery nurse	F	14.12.11	19
	F	14.12.11	23.5
	F	15.12.11	16
	F	19.12.11	2.5
	F	20.12.11	4
	F	21.12.11	13
	F	21.12.11	11
	F	23.12.11	11
	F	06.01.12	13
	F	09.01.12	7
Consultant Orthopaedic Surgeon	M	21.12.11	5
	M	23.12.11	8.5
	M	06.01.12	5
	M	06.01.12	9
Consultant Plastic Surgeon	M	22.02.12	10
	F	24.02.12	2.5
	M	21.12.11	1.5

3.3.2 Information about handover and its relevance

3.3.2.1 Ideal handover

Following the initial demographic question as to how long they had worked at the hospital for and what their role was, the interviewees were asked to describe an ideal handover and relate this to their practice in their current hospital. All of the specialities involved provided descriptions of their ideal handover and volunteered information on environmental considerations which would aid the process.

3.3.2.1.1 Anaesthetists

All of the anaesthetists described an ideal post-operative handover as taking place between the recovery nurse and the anaesthetist. Two of the anaesthetists highlighted the advantage of knowing the recovery nurses they were handing over to. One described how this increased their confidence in the handover *'we know our (recovery) nurses and we know we can rely on them so we work as a team'* (AN 02.02.15.15). Another said that this enabled them to *'cut corners and abbreviate'* (AN 08.02.12.15.40), however this anaesthetist then reflected *'I suppose to do it properly I should be doing it the same in every single instance'* (AN 08.02.12.15.40). This anaesthetist also described a recent involvement in a critical incident relating to handover and how this spurred the introduction of a *'formalised and more structured and written handover'* (AN 08.02.12.15.40).

Another anaesthetist was open with the conflict between 'ideal' practice and what was practical '*going through that [RCoAn guidance] in every patient is disproportionate and so that is why I cut corners'* (AN 31.01.12.15.00). Two of the anaesthetists listed specific information points they felt were essential for a safe handover.

A reason for the perception of impracticality with the guidelines is pressure of time on the handover process. Three anaesthetists volunteered that they felt under some pressure to

keep the operating list moving which seemed to truncate their handover (AN 06.02.12.16.15), (AN 08.02.12.15.40) and (AN 31.01.12.15.00). One said that they liked to see one set of full observations before leaving the patient (AN 07.12.11.16.40).

Five anaesthetists recommended the following rules:

- Wait until the recovery nurse attached the monitoring (AN 15.02.12.12.30)
- The recovery nurse looked at you and made notes (AN 15.02.12.12.30)
- Systematic approach (AN 15.02.12.12.30)
- No distractions (AN 06.02.12.16.15), (AN 25.01.12.08.50)
- something like a WHO check [WHO surgical safety checklist] (183) (AN 07.12.11.16.40) (AN 08.02.12.15.40)
- Delivery of the information in a very succinct period of time (AN 06.02.12.16.15)
- somebody else was putting the monitoring in place (AN 06.02.12.16.15)

3.3.2.1.2 Recovery nurses

Most of the recovery nurses (7/10) listed specific information required for the ideal handover. Almost all of the recovery nurses felt that an ideal handover would involve the anaesthetist; one suggested that a scrub nurse should be present too (RN 15.12.11.16.15) and another requested that the surgeon arrived about 5 minutes after the first handover (RN 14.12.11.11.45). One felt that the patient should be involved in the handover, to encourage information sharing, patient empowerment and quality checking *'get the patient involved as you are handing over your report because it is their care that we are talking about and I don't want the patient to feel that you know he's there but being ignored'* (RN 21.12.11.18.00).

Two recovery nurses recommended rules for the post-operative handover:

- Anaesthetist would arrive nice and calm (RN 14.12.11.12.30)

- A bed space that was absolutely clean and a nurse ready and waiting (RN 14.12.11.12.30)
- Connect the patient to the monitoring together and he would be able to tell me about the patient while we stood and watched the patient and presumably airway (RN 14.12.11.12.30)
- The anaesthetist just needs to wait a minute, just let us settle the patient then handover (RN 14.12.11.11.45)
- Working through it systematically I think would be helpful for all staff so that you know you have mentally ticked off (RN 14.12.11.11.45)

At the end of this question, one of the recovery nurses reflected in a wistful way *'and we try and achieve that but, you know!'* (RN 14.12.11.12.30).

3.3.2.1.3 Surgeons

A surgeon opened their description of an ideal handover with the admission that *'I think the post-operative handover are notoriously done badly in terms of a formal handover'* (S 21.12.11.10.30). One surgeon described a practice in Denmark, where enhanced recovery scheme provided continuity of care from the pre to post-operative period (S 06.01.12.11.00). Another harked back to prior practice *'we'd do a post-operative ward round and you go round and see all of your patients post-op and that would be another opportunity to formally handover to the nursing staff'* (S 21.12.11.10.30). Another surgeon drew on experience from cardiac theatres whereby a handover happened to the receiving recovery nurse within theatre, with a second handover happening with a representative of the surgical and anaesthetic team in intensive care. He stated that *'everyone (…) involved in direct transfer of information rather than indirect'* (S 06.02.12.12.10). This concept was unique amongst all interviewees.

Some surgeons volunteered some ground rules for the handover including:

- The location (S 22.02.12.08.40) (S 06.02.12.12.10)
- The use of an aide-memoir or checklist (S 21.12.11.10.30)
- Lack of distractions (S 21.12.11.10.30)
- It happens concisely (S 24.02.12.12.35)
- There is time for questions (S 24.02.12.12.35)
- There is written information (S 21.12.11.13.07)
- Able to happen in a free and open forum (S 21.12.11.10.30)

Overall, all of the surgeons felt that their current handover practice was good, however one commented that *'It tends to be each person splits up into their little team and says their little bit so I might go and speak to the recovery nurse, the anaesthetist might speak to the recovery nurse at a different moment time so it all happens but it happens in a slightly ad hoc way'* (S 21.12.11.10.30).

3.3.2.1.4 Summary of experience

There seems to be concordance between the disciplines on a number of topics. The recovery nurses and anaesthetists defined an ideal post-operative handover as one happening between each other. Only one recovery nurse requested that the surgeon was present and another that the patient was involved. The surgeon declared that their input is minimal with '*we don't handover anything other than via the operation note'* (S 24.02.12.12.35).

The effect of time on the post-operative handover seemed to be another strong theme with the recovery nurses requesting that the anaesthetists '*The anaesthetist just needs to wait a minute, just let us settle the patient then handover*' (RN 14.12.11.11.45) and the anaesthetists '*Delivery of the information in a very succinct period of time'* (AN 06.02.12.16.15). The recovery nurses and anaesthetists, perhaps in response to this both brought up the importance of separating the task of connecting the monitoring to the

patient and handing over with the recovery nurses asking *'We would be able to connect the patient to the monitoring together'* (RN 14.12.11.12.30) and the anaesthetists *'somebody else was putting the monitoring'* (AN 06.02.12.16.15) or *'wait until the recovery nurse attached the monitoring'* (AN 15.02.12.12.30).

The recovery nurses and anaesthetists both described the importance of having a prepared bed space and a calm working environment (RN 14.12.11.12.30), (AN 06.02.12.16.15) and (AN 25.01.12.08.50). There seemed to be some difference of opinion as to where the handover should happen in the surgeons' minds with some declaring that it should be in theatre and others that it should be in recovery (S 22.02.12.08.40). This conflict was shared by some of the anaesthetists with one saying that it would be good for the recovery nurse to come into theatre whilst the skin was being stitched to enable them to get to know their patient (AN 25.01.12.08.50).

Two of the anaesthetists revealed internal conflicts between their ideal standards and the reality of practice, with one comparing their practice in another speciality (AN 08.02.12.15.40) and the other with RCoAn (Royal College of Anaesthetists) guidelines (251) (AN 31.01.12.15.00). The interviewees seemed not to resolve these differences during consideration of this question. All of the disciplines interviewed felt that some form of standardisation would aid the information transfer during handover.

Overall a good handover seemed to be one that happened in recovery, where the tasks and handover were separated, between a recovery nurse and anaesthetist in a standardised way with minimal distractions and time pressure.

3.3.2.2 Poor handover

Following the focus on an ideal handover, the interviewees were asked to describe a poor handover.

3.3.2.2.1 Anaesthetists

One anaesthetist described a poor handover as a *'dump and run, where you leave a patient in a powerless state with no real information handed over to the next team without highlighting critical incidents or potential problems that are going to be encountered'* (AN 08.02.12.15.40). Six of the interviewed anaesthetists described a poor handover as one lacking contextual detail in the handover. One anaesthetist felt that a poor handover would rely too much on the recovery nurse to seek out information from the anaesthetist (AN15.12.11.14.52).

As in the description of a good handover, the importance of the perception of sufficient time was revealed in the descriptions of a poor handover which would feel '*hurried*' (AN 07.12.11.16.40). The reason for the hurry was explained as being due to '*pressure of time, pressure of work'* (AN 15.02.12.12.30), with the '*time pressure to get involved in the next case without being quite certain enough that the first case has landed safely'* (AN 07.12.11.16.40). One of the anaesthetists felt that they should be more patient and wait to handover once all the monitoring had been put on the patient, however, they found this difficult when they '*are trying to run a high turnover [theatre] list'* (AN06.02.12.16.15). One of the anaesthetist reflected upon the readiness of the patient to be transferred noting that '*If the patient isn't in a good quality state if they are being transferred out of theatre too early….maybe there's pressure on the [theatre] list'* (AN 15.02.12.12.30).

Some of the anaesthetists pointed to the negative influence of distractions from the verbal handover. They described both internal distractions that the nurse might be going through '*Not listening(…)the nurse being distracted'* (AN 15.02.12.12.30); from patient-related tasks '*The nurse is distracted by doing other things other than actively listening well to the handover or the anaesthetist is not giving a clear handover'* (AN 06.02.02.12.16.15) or work

pressure relating to other patients in recovery '*the recovery nurses being pulled in different directions looking after several patients* (AN 21.01.12.15.00)'.

Two anaesthetists spoke on the theme of responsibility with one describing a serious incident in which a patient died as *'I [the anaesthetist] had no idea that the nurse I had handed over to was a completely untrained student nurse who didn't observe the airway for 10 minutes and the patient died of airway failure'* (AN07.12.11.16.40). Another felt that the most dangerous situation would be *'where the anaesthetist […] handed over and someone else has taken responsibility and the recovery staff not realising that they have accepted responsibility'* (AN31.01.12.15.00).

3.3.2.2.2 Recovery nurses

Four of the interviewed recovery nurses stated that a poor handover would limit the quality of the information handed over, with three of them outlining examples ''*you'll really like this guy he's a computer nerd' and walked off*' (RN14.12.11.12.30) or ''*This guy is reasonably fit and healthy and he should be alright' and off they go'* (RN23.12.11.11.45). One recovery nurse explained why these brief handovers may happen '*Sometimes the anaesthetist knows that you have been here a long time and that you know roughly what to expect and you know each anaesthetists anaesthetic it's sometimes they do miss a few things out and I can't say its they might have forgotten to say with surgery they've had*' (RN14.12.11.11.45). One of the recovery nurses felt that the newly introduced computer system hampered a safe handover *'it's so difficult to look for the information(…)we are forgetting what we are going to tell the nurse'* (RN 21.12.11.18.00).

One nurse felt very passionate about the effect of a poor handover on the quality of her work '*I feel upset(…)basically means I am going to be searching for all this information rather than giving my care to the patient*' (RN21.12.11.18.00). One nurse reported that she had previously complained about the quality of a handover however '*people challenge me,*

you are not a doctor, who are you to say?' (RN15.12.11.16.15). The same recovery nurse had also had occasions where the documentation was either incomplete '*It can be scary because you get anaesthetic charts and there's no patient name on it there's no HCA name on I you have all the drugs given(…)you find the anaesthetist's name and you assume it's them and it's on that patient bed so you assume it's them, so all those are risks and we're just lucky sometimes'* (RN15.12.11.16.15) or missing '*I've had the wrong documentation too somebody else's anaesthetic chart inside'* (RN15.12.11.16.15).

Two of the recovery nurses specifically mentioned the effect of time pressure of time, it feels '*rushed'* (RN14.12.11.11.45), with one stating that the patient's '*airway is compromised*' (RN09.01.12.11.45).

3.3.2.2.3 Surgeons

One of the surgeons summarised the definition of a poor handover as *'if the person in recovery either didn't understand or didn't know they didn't understand; or didn't understand and couldn't feel that they could say that they didn't understand'* (S24.02.12.12.35). Another surgeon felt that if the nurse received mixed messages this would count as a poor handover (S21.12.11.10.30). The remaining surgeons felt that a poor handover would consist of a *'dump and run'* with very little information handed over.

3.3.2.2.4 Summary of experience

One of the commonest themes in all of the disciplines interviewed was that a poor handover would be a *'dump and run'*, whereby the patient is left in a '*powerless'* position (AN 08.02.12.15.40) (S23.12.11.12.00) (S06.01.12.11.00). The anaesthetists brought up the feeling of time pressure more than the other professional groups. They sometimes felt under pressure to keep the operating list going which resulted in them feeling torn between staying with the recovering patient and starting the next anaesthetic. The anaesthetists also brought up the negative influence of distractions upon the handover.

There seems to be a tension between knowing your colleague's abilities whilst still handing over information in a formal and structured way. The anaesthetists value knowing the abilities of the recovery nurses whilst the recovery nurses note that some of their regular anaesthetists give a scant handover as they expect them to remember or 'know' what has happened. Perhaps the familiarity between the recovery nurses and anaesthetists has an opposite effect that one might expect. Rather than improving patient outcome by tight team working, there may in fact be greater temptation to take shortcuts or concern that by giving too much information you may be implying a lack of knowledge in the receiver.

Distractions were mentioned as a negative influence by all of the disciplines. One recovery nurse spoke specifically of the negative influence of the new computer system and how this impacted upon her ability to easily access clinical information for her handover to the ward nurses.

3.3.3 Who should be involved in the handover

The interviewees were asked who they thought should be involved in the handover process and there was consensus that the handover should occur between the recovery nurse and the anaesthetist, as one surgeon stated *'immediate handover is always going to be between the anaesthetist and the recovery nurse'* (S21.12.11.13.07).

All interviewees seemed to feel that the surgeon should not be involved in the initial handover. Some recovery nurses felt *'if there are too many people interfering it's almost you know a pain really'* (RN21.12.11.17.09) and a surgeon agreed *'If you have too many people then the communication lines get confused'* (S06.01.12.11.00).

The recovery nurses found that having a colleague with them to assist in connecting the monitoring or performing patient-focused tasks aided the handover *'with the big cases there is a lot to do and you know you want the patient to be comfortable and warm if there*

is enough colleagues about to actually start that and on the whole we have good team' (RN14.12.11.11.45). The recovery manager seemed particularly keen on this practice *'I try to force that culture, just keep quiet and do the tasks'* (RN15.12.11.16.15).

The recovery nurses felt that surgeons should take part towards the end of the handover or at a later time when the patient has woken. They specifically felt that they could inform them as to the need for anticoagulants (RN20.12.11.18.00) (RN06.01.12.12.00).

3.3.4 Roles and responsibilities

The interviewees were asked to describe their roles and responsibilities in the post-operative handover. The questions were designed to attempt to separate the interviewee's perception of their official role in the post-operative handover and how this might fit into the realities of day to day practice.

3.3.4.1 Anaesthetists

Most of the anaesthetists stated that their official role was to ensure that the receiving nurse had sufficient information about the patient to care for them. A couple of the anaesthetists discussed the issue of knowing if the recovery nurse had received adequate information and if they'd listened to the handover. *'Sometimes you give the handover and you know that they are not listening (…) I wonder sometimes about how much of what I have said has actually been remembered or recalled and used again'* (AN15.02.12.12.30). One attempted to establish confirmation of understanding by asking *'are you OK now?'* (AN07.12.11.16.40). One revealed that they attempted to wait until they knew they had the nurses' full attention *'but sometimes with a high turnover list there is a bit of an overlap'* (AN06.02.02.12.16.15).

One anaesthetist stated that their role was to transfer responsibility for the patient to another team. Another explained the difference between an ideal handover and how this

lays out in real life, comparing the ideal as a list of key information points and a *'one line handover because you know the staff, they know what you've done in theatre'* (AN15.12.11.14.25).

3.3.4.2 Recovery nurses

The nursing staff defined their roles and responsibilities including: welcoming the patient and attending to their needs; listening to the anaesthetic handover and taking notes; attaching the monitoring and recording observations and acting as gatekeeper for the anaesthetists' departure. Some of the recovery nurses reflected upon the conflict that these roles bring.

- Between direct patient care and listening to the handover:
    - '*In a major case and if the patient is in a lot of pain, you don't always take in what's been said because there is a lot going on and you're focusing, you're trying to make sure the patient feels reassured and you're getting pain relief. If I've missed anything I'd go through the paperwork but if I'm still not happy I'd go through and speak to the anaesthetist, I'd personally like to do it face to face than phone'* (RN14.12.11.11.45).
    - '*At the same time as I'm listening to the anaesthetist I'm attaching the patient to the monitoring and trying to record some of what the anaesthetist says to me, but at the same time we have a patient between us and the patient has to be looked after so you know we're talking but the important bit is the patient*' (RN14.12.11.12.30).
    - *'I have to make myself available as soon as possible and if I've got patients elsewhere I have to make sure that patient is safe(…)I introduce myself to the patient, but sometimes it is very difficult if the anaesthetist is talking, I don't want to make the anaesthetist think I am not listening'* (RN21.12.11.18.00).

- Maintaining working relationships and patient care:
    - *'some anaesthetists will ask you if you're happy and you feel that you should say that you are happy(…)sometimes you compromise patients because people will feel if I'm the one saying 'no you cannot go' you look like a bad person, so in real life it doesn't always happen'* (RN14.12.11.16.15).
    - *'I [the nurse manager] spend my life trying to say to the nurses it's not about you it's about the patient. If you are not happy, you have to go and say that you are not happy. It sometimes leads to disruptions (…) because you barge into an anaesthetic room when they are with another patient distracting them which is unsafe for patients and it is unfair because they are going to shout at you and it kills your confidence'* (RN14.12.11.16.15).
- Adaptation of working allocations
    - *'until the anaesthetist has gone I have to be 100% listening to what they are telling me and remembering everything and writing everything down, quite often we have two staff to try and connect the patient up to everything so that I can just absorb the information I've been told*' (RN21.12.11.17.09)
- Time pressure
    - *'it really does depend upon the patient and the anaesthetist as to how much information you are given and how long they stay for cause sometimes it is so brief, cause obviously they are under pressure and have a list to do, but I think cause maybe I've been here for a long time and they get to know you and they trust you' 'not many of them will say 'do you want me to stay' they'll just assume that they've handed over to you and everything's fine and they'll go but quite often you know, they'll say 'I'm in theatre 5 if you need me''* (RN21.12.11.17.09).

Three of the recovery nurses reflected upon the great importance and responsibility they felt for managing and maintaining a patient's airway *'if the patient has an LMA in that's a big responsibility'* (RN23.12.11.11.45).

3.3.4.3 Surgeons

The surgeons reflected that the post-operative handover was primarily the task of the anaesthetist and the recovery nurses, with one of them stating *'I don't have any direct responsibility between the handover of the anaesthetised patient'* (S23.12.11.12.00). This seems to be in accord with the recovery nurse and anaesthetist's impression of the process. One of the surgeons said that they never lose responsibility for the patient as *'they are always under my care(…)[however] for a more routine patient, my responsibility tends to finish the time the patient is put back on the bed and is comfortable'* (S06.01.12.11.00).

Most of the surgeons described communication with the recovery team in an asynchronous fashion with the post-operative handover *'it will be written down in the notes as to the immediate post-operative problems'* (S21.12.11.13.07).

3.3.4.4 Summary of experience

There seems to be concordance between the interviewees as to the roles and responsibilities. The post-operative handover is seen as a task for which the anaesthetist and recovery nurse are responsible, with some underlying asynchronous communication and support from the surgeons. The anaesthetists described the handover primarily as a communication event between themselves and the recovery team, whereas the recovery nurses provided a richer description of the complexities of the process and how this affected the process. One recovery nurse summarised *'you may not have heard everything because it's the environment, attitude and the documentation because the patient has a blank anaesthetic chart'* (RN14.12.11.16.15). There appears to be differing pressures on the

anaesthetist and recovery nurses, with the anaesthetists feeling pressurised to continue with the operating list as quickly as possible and the recovery nurses therefore feeling they have to act as a blocker to maintain patient safety.

3.3.5 Rules for post-operative handover

3.3.5.1 Anaesthetists' rules

Within the anaesthetic interviews there seemed to be a common theme of an uncertainty or ambiguity as to the recovery nurses' involvement in airway management and when they (the anaesthetists) are free to leave the patient and return to theatre for the next case: *'it's always been my practice personally to remove the LMA, but others would say I'm wrong'* (AN07.12.11.16.40); *'there is huge variation, some people leave patients with laryngeal masks in and wander back and start the next case, some people leave recovery nurses doing jaw thrusts and they are quite unconscious patients. This usually happens due to pressure of work, certainly no one would consider this as ideal'* (AN15.02.12.12.30); '*the anaesthetist to remain available and partly responsible until not needed, and for the recovery nurse to show independence and initiative for their rank and experience'* (AN07.12.11.16.40). One anaesthetist summed up: *'I would hope there was a minimum standard that we all met but there isn't as far as I'm aware'* (AN06.02.12.16.15).

There seems to be a tension between a minimum standard and what is practical in an anaesthetist's mind *'if it's an arthroscopy and they've been in theatre for 15 minutes they are not going to get the same handover as someone who has had an aortic valve replacement and has been bleeding out 6 litres and things like that and there is a risk of death that evening(…)I cannot give just a standardise type of handover, much as everyone would like a laminated card there'* (AN08.02.12.15.40). One anaesthetist felt that there would be a detrimental effect of handing over *'too many'* information points as there

would be concerns of *'diluting'* the important information (AN15.12.11.14.25). One anaesthetist said that '*at some point there has to be a response from someone so you cannot have a non-speaker in the handover (…) it's a red flag'* (AN31.01.12.15.00).

3.3.5.2 Recovery nurse rules

A recovery nurse reported that there were no official rules relating to the practice of handover (RN06.01.12.12.00). One recovery nurse said that there are times when it is impossible to immediately attend an arriving anaesthetist with their patient, however they managed the situation by asking them to wait as it is *'much better if you handover directly to the person who is looking after the patient if at all possible'* (RN14.12.11.12.30).

There was some description as to when the anaesthetist would be able to leave. Two recovery nurses preferred the anaesthetists to stay until a complete set of observations had been gathered (RN14.12.11.11.45) (RN21.12.11.18.00). Another spoke about how the negotiation happened between the anaesthetist and the recovery nurse *'don't ask the nurses if they are 'happy', they themselves make the assessment with the nurse and say 'I've assessed the patient and they are safe'* (RN15.12.11.16.15). They further elaborated upon the concept of responsibility for the patient stating that the nurse should not be responsible for the rest of the anaesthetic course (RN15.12.11.16.15).

Another nurse highlighted the importance of a good handover as it meant that she did not have to go looking for information in the computer and manage the airway at the same time (RN20.12.11.18.00). Another nurse found that she always looked at the paperwork to make sure they had not missed anything (RN09.01.12.11.45). One recovery nurse felt that if there was an especially concerning patient that the anaesthetist should handover this to the oncall doctor so that they can be contacted for further support (RN15.12.11.16.15).

3.3.5.3 Surgeon rules

The surgeons described varying their handover as to the complexity of the case *'if it was a big case where there things out of the ordinary I'd personally go and speak to the recovery staff which would be a rule'* (S21.12.11.10.30) and *'if I don't go round to say something specifically to the nurses in recovery then I'm sort of saying that this is routine procedure'* (S06.01.12.11.00).

One of the surgeons agreed with the anaesthetist saying that only the important information should be handed over (S22.02.12.08.40). Another surgeon stated that there should be considerations in the staffing to make it more conducive to receive the patients (S23.12.11.12.00).

3.3.5.4 Summary of experience

Tension seems to exist between the anaesthetists and recovery nurses as to what role each party has in the care of the patient in the immediate post-operative period. As before, the anaesthetists referred to particular instances, such as the management of airway devices, whereas the recovery nurses referred to the overall transfer of responsibility. The recovery nurses objected to being asked if they were 'happy' to care for a patient and also described unease in requesting the anaesthetist to stay longer in recovery.

3.3.6 Three most important things for handover

At the end of the interview the interviewees were asked to list the three most important things for a successful handover. Some responded with a list of information points, whereas others described characteristics of a safe handover at a greater distance.

An anaesthetist felt that a safe handover would *'clearly handover the care from one team to another in a way that is unambiguous as to what their responsibilities are and the information that they are given to enable them to do that and to devise a system to do that'*

(AN08.02.12.15.40). Another anaesthetist impressed the utmost importance on the management of the patient's airway describing the variation in practice less than ideal (AN15.02.12.12.30).

The recovery nurses felt that a safe handover would involve the feeling of sufficient time, in a quiet environment with the ability to ask the anaesthetist to stay and assist if necessary. A recovery nurse impressed the importance of a direct handover between the anaesthetist who anaesthetised the patient and the recovery nurse who will care for the patient in the post-operative period (RN06.01.12.12.00).

The surgeons felt that it was important that all necessary parties were present and had sufficient time to handover information, paying particular heed to unusual or out of the ordinary information points (S21.12.11.10.30) and (S21.12.11.13.07). A surgeon also felt that a feedback loop, confirmation of understanding would be advantageous (S22.02.12.08.40).

3.4 Discussion

3.4.1 Of method

Interview studies are undertaken to permit exploration of an issue with a defined population (252). The area of interest is frequently elicited from ethnographic study whereby practitioners observe an activity within its context, identifying potential significant or pivotal processes (253, 254). The role of interview studies is to formally record, analyse, and potentially quantify expert opinions, revealing new insights into previously hidden processes (255).

The qualitative researcher is considered an active participant in the process and it is possible for the researcher to influence the outcome of the investigation at a number of stages: from the selection of area of study to method and analytical style. The qualitative

continuum ranges from art/impressionist, middle ground and science/realist This continuum ranges from the paradigm that all experience and situations are unique, with learning likewise remaining unique, to the theory of real similarity between experiences permitting transference of learning. Researchers are placed somewhere along this continuum and I felt that I likely stood somewhere between the middle ground and science/realist. I felt this was most representative of my research approach due to my scientific background and belief that it is possible to capture and transfer learning from one environment/situation to another.

The researcher must decide upon whether transferrable meaning can be extracted from the investigation of a discrete process. This will influence the overall aim of the study, either by investigating a process or event while holding a viewpoint of commonality with others or by deciding that the area of focus is so unique, it is not possible to translate meaning to other environments. If it is decided that the area of research can be translated or have resonance with another area of work, the researcher must attempt to sample a representative population, preferably in an unbiased fashion though the process of randomisation (256). However, randomisation is generally only applicable for qualitative research where an *a priori* theory can drive selection. In qualitative research where a theory may be constructed through the accrual of research information, the method of sampling must be adapted accordingly. It is also recognised that some participants may provide a richer dialogue for analysis, thereby increasing their contribution to analytical theme development and study findings in a way which would be unacceptable in a qualitative framework (255, 257). Qualitative sampling therefore tends to focus on the characteristics of the participants which the researcher is interested in, rather than their demographic information and may indeed recruit further interviewees once the study has begun relying upon analysed data (258).

The qualitative researcher is often not guided or restricted by an *a priori* hypothesis or statistical plan, they bring a viewpoint to the area of interest which guides their investigation (255). It remains contentious as to whether researchers can flit between differing analytical models or if an indwelling preference will always remain with the researcher. This, within a quantitative framework could be considered bias, however; within a qualitative realist framework it is accepted that more than one 'truth' exists (258, 259).

The style of interview is influenced by the previous explorations within the area of focus(260). If understanding of the field is limited, unstructured interviews facilitate wide exploration(261, 262). This framework permits the interviewee to guide the conversation and focus upon areas which they consider pertinent as the researcher does not impose any *a priori* categorisation. The interviewee is free to emphasise or restrict the areas of exploration to the interviewer. As the interviewee is able to influence the focus of the interview, there is a risk that the interview settles upon an unfruitful area of discussion or there are areas of omission due to a lack of direction. It was felt that the utilisation of unstructured interview techniques would not be of benefit as a body of ethnographic and group interview analysis already exists (117, 123, 263).

The construction of semi-structured interview questions is a potentially perilous task as the researcher needs to judge whether relevancy exists between previous research and their current field (264). In comparison to an unstructured interview, the addition of a pre-designed framework risks the accidental omission or oversight of key areas due to interviewer assumption rather than interviewee bias. In an attempt to reduce the chance of this, a pre-interview analysis of the literature was undertaken to understand previous findings in allied clinical areas (i.e. shift handover (171, 265) or accident and emergency handover (114)).

The wording of questions can induce bias to the interview process (266). In an attempt to reduce misunderstanding, the interview questions were reviewed by four independent reviewers who are experts in their own field (2 human factors, 1 operating department practitioner and 1 professor in primary care). Each of the reviewers offered insights into how the questions could be altered to reduce the risk of ambiguity or misinterpretation. The questions were then tested in one pilot interview with a recovery nurse.

In order to reduce inter-interview variability, all of the interviews were carried out by one interviewer (ER) and questions were asked in a consistent manner *'so we can be sure that any differences in the answers are due to differences among the respondents rather than in the questions asked'* (267). Throughout all of the interviews consistency was actively sought and achieved by ensuring the questions were asked in a neutral tone and the interviewers were given sufficient time to consider the question and answer prior to progressing to the next question (109, 268, 269).

It was felt that the post-operative handover had yet to be explored in sufficient detail as to make the administration of surveys to a wider audience at risk of bias from omissions. Due to the inherent narrow nature of the questions, larger sample sizes than typically used with unstructured or semi-structured interviews are often required to enhance reliability.

In retrospect, it may have proved fruitful to undertake a framework analysis technique rather than the utilisation of grounded theory (270). This technique would have aligned well with the main objectives of the study which was to explore inter-professional similarities and differences in the post-operative handover. The method's matrix output would permit analysis of themes within a strict framework of cases and codes. This would have enabled analysis in multiple dimensions: from individual interviewees or tribes to thematic analysis (271).

3.4.2 Discussion of findings

The delivery of high quality safe care requires considered transfers between providers. It is clear from the interviews that this is achieved in the majority of occasions. However the process is subject to variation in quality which appears to arise from clinicians attempting to balance conflicting priorities. These pressures can be considered within three main themes of time, task and transfer which correlate well with Bost's findings of interruptions, workload, relationships and responsibility (114).

3.4.2.1 Time

3.4.2.1.1 This study

One of the major themes of the interview study was the pressure of time. This was particularly strong in the anaesthetists and recovery nurses' interviews. There appears to be an intriguing relationship between the surgeons, anaesthetists and recovery nurses, with the perception of time pressure affecting the others' work. There may be a circle of pressure between the surgeons expecting the anaesthetist to handover patients in a timely fashion which in turn increases the pressure on the recovery nurses to agree to truncated handovers. From the interviews it is possible to develop a theoretical model of time pressure influence between these key players in the post-operative handover. It becomes clear that there is substantial pressure placed upon the recovery nurse to perform the task quickly in a less than optimal environment (Figure 18).

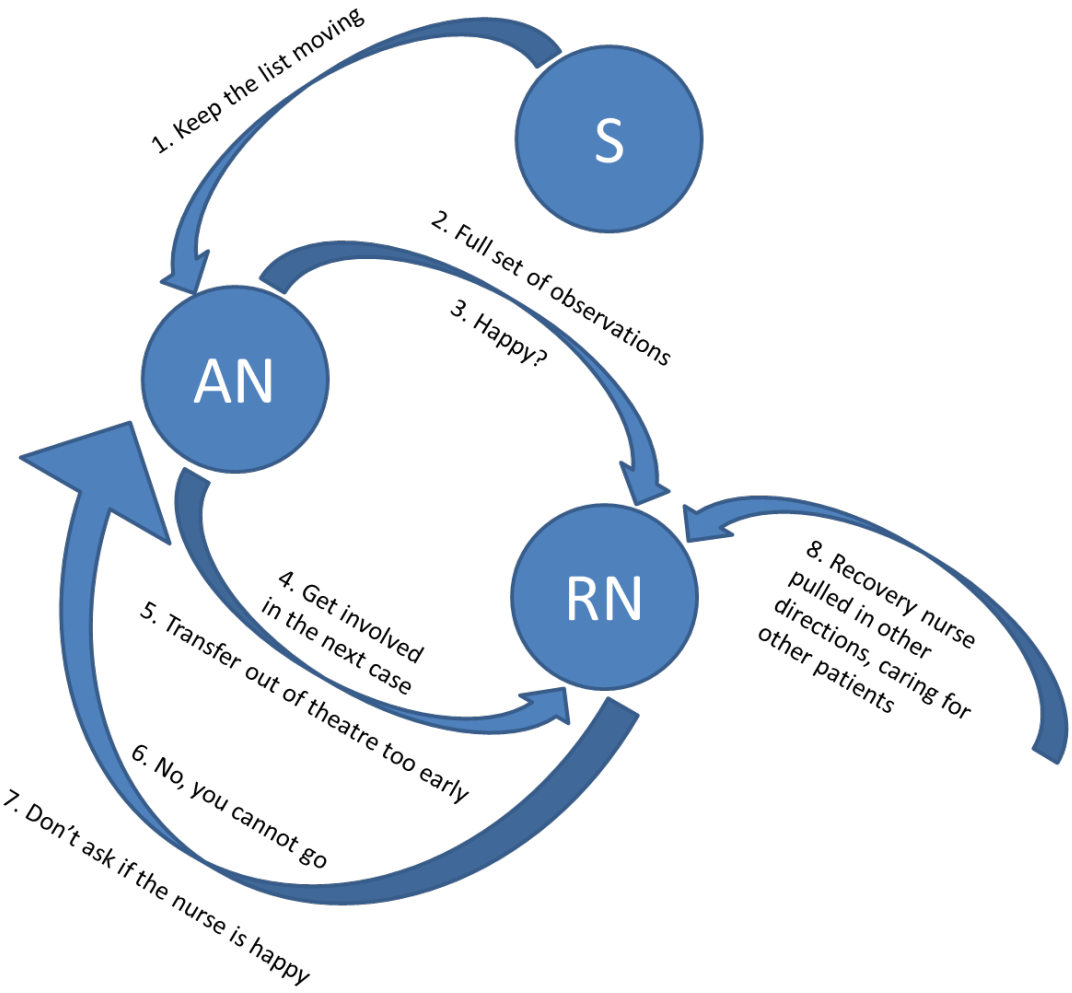

Figure 18 Influences to speed up handover: 1.(AN0602121615); 3.(RN14.12.11.16.15); 4.(AN0712111640); 5.(AN1502121230) and influences to slow down handover: 2.(AN0712111640); 6.(RN1412111615); 7.(RN1512111615); 8.(AN21.01.12.15.00)

The anaesthetists revealed a tension between caring for the patient in their immediate care whilst also considering the needs of the ongoing theatre list. The anaesthetists reported feeling under pressure to transfer the care of the patient as quickly as possible following the completion of the operation in order to continue with the ongoing surgical list. One anaesthetist revealed that this sometimes interfered with their ideal model of handover admitting that they felt they couldn't wait to have the nurses' full attention prior to commencing the handover.

The recovery nurses, in response to their awareness of the anaesthetist's desire to leave the patient, felt they had to act as blockers to maintain patient safety. One recovery nurse directly referred to the time constraints the anaesthetist is under '*they are under pressure and have a list to do*' (RN21.12.11.17.09). The nursing manager admitted that she was aware of the pressure for her nurses to say that they were happy for the anaesthetist to leave the patient and return to theatre. She reported that she found herself repeatedly encouraging her team not to let the anaesthetist leave until they were satisfied as to the condition of the patient. She went on to expand the impact of the interruption not only to the safety of the subsequent patient but also to inter-disciplinary working. Another nurse reflected that the speed of the handover may relate to their long working relationship, with the anaesthetists expecting the nursing staff to 'know' their patient's needs implicitly. The nurses revealed their hesitancy in stopping the anaesthetist from leaving as it may reflect poorly on them.

The anaesthetists seemed to be accepting of downstream interruptions, with most of the interviewed anaesthetists referring to the recovery nurses' double checking information at a later date. One anaesthetist seemed to positively encourage nurses speaking to him about his patients. This view seems to conflict with the nursing manager's view of the process. She seems to see the handover as a unique opportunity for information transfer and once that happened, the moment has passed, whereas the anaesthetists feel that their responsibility and availability should extend beyond the handover.

3.4.2.1.2 Previous work

The effect of time pressure on handover has been noted in handovers in similar clinical and non-clinical situations. A trade-off exists between efficiency and thoroughness, whereby time spent in the handover process will conceivably save time in the long run (272). A study in a similarly stressful, multidisciplinary environment found that the condition of the

patient affected the quality of the handover and the nurses' satisfaction with the process (118). In the transfer from A&E to ITU, the handover was thought to be under too much time pressure with a lack of structure (124).

An ethnographic study exploring the post-operative handover between anaesthetists and recovery nurses found that the recovery nurses were reluctant to say outright that they were not 'happy' for the anaesthetist to leave. The recovery nurses were seen to be maintaining standards of safety whilst avoiding a direct conflict with the anaesthetists (117). This finding is similar to that reported by the recovery nurses in this interview study with one respondent summing up the feeling as *'don't ask the nurses if they are 'happy', they themselves make the assessment with the nurse and say 'I've assessed the patient and they are safe'* (RN15.12.11.16.15). Still some nurses felt under pressure to release the anaesthetist back to the ongoing list: *'some anaesthetists will ask you if you're happy and you feel that you should say that you are happy (…) sometimes you compromise patients because people will feel if I'm the one saying 'no you cannot go' you look like a bad person, so in real life it doesn't always happen'* (RN14.12.11.16.15).

This concept of challenging the anaesthetist or requesting them to stay clearly causes difficulty for the recovery nurses. From the interview with the nursing manager, it is clear that encouraging her nurses to say 'no' to the anaesthetist and preventing them from leaving until they are satisfied with the condition of the patient has become a major issue. The reluctance to enter into direct conflict with doctors is something which has been noted in inter-disciplinary working (136, 137).

There also seems to be support for the observed finding that there appears to be an element of uncertainty in the process with a recovery nurse feeling that they should not be responsible for the whole post-operative course (RN15.12.11.16.15), a surgeon stating that they maintain responsibility throughout the process (S06.01.12.11.00) and an anaesthetist

stating that they transfer responsibility after the handover (AN08.02.12.15.40) with another stating that they are responsible for the patient whilst they are in recovery (AN 07.12.11.16.40). This pattern of informal transfer of responsibility seems to be in accord with previous findings. A previous study found that 5 to 6% of all anaesthetic critical incidents occurred within the recovery suite, with the majority of these relating to cardiovascular, respiratory or airway emergencies (273, 274). These incidents were more likely to have greater consequences than those occurring in the operating theatre and one downstream effect noted was an increased length of stay (275). It should be noted that the majority of patients suffering adverse events were not systemically unwell as they were more likely to be graded as ASA (American Society of Anaesthesiologists) 1 or 2 (1 = Healthy person, 2 = Mild systemic disease) rather than the more morbid ASA 3 or 4 (3 = Severe systemic disease, 4 = Severe systemic disease that is a constant threat to life) (273). As these emergencies frequently require timely intervention and had a high likelihood of morbidity, it is understandable that the recovery nurses and anaesthetists are considering who is in overall charge of the patient in recovery.

3.4.2.2 Tasks

3.4.2.2.1 In this study

Anaesthetists reported finding it difficult to know if the nursing staff were listening to the handover due to the activity of work (AN15.02.12.12.30) (AN06.02.02.12.16.15). They noted that these distractions could come from activities relating to the patient they were immediately caring for (AN 06.02.02.12.16.15), other patients under the nurses' care in recovery (AN 21.01.12.15.00) or from general background noise and disturbances (AN 15.02.12.12.30).

The nursing staff, having recognised the conflict between attaching the monitoring and listening to the handover had created a number of work arounds. One, which was

recommended by the recovery nurse manager was to have an additional nurse to attach the monitoring, thereby freeing up the receiving nurse to listen to the handover (RN15.12.11.16.15). Other nurses described an ideal handover as being where the tasks were shared with the anaesthetist (RN 14.12.11.12.30) or even just waiting until the patient was settled prior to handing over (RN 14.12.11.11.45). The conflict which the nursing staff are feeling was elegantly summarised by one recovery nurse: *'At the same time as I'm listening to the anaesthetist I'm attaching the patient to the monitoring and trying to record some of what the anaesthetist says to me, but at the same time we have a patient between us and the patient has to be looked after so you know we're talking but the important bit is the patient'* (RN14.12.11.12.30). The anaesthetists were also aware of the impact of tasks on the nurse's ability to recall information *'people cannot concentrate on re-establishing monitoring and just eye-balling the patient […] I'm sure the receiving nurses are busy pulling out laryngeal mask and putting up the drip poles and things like that at the same time while you keep giving a verbal handover'* (AN 08.02.12.15.40).

This conflict of interests was alluded to by both anaesthetists and recovery nurses, with rules for effective handover including: commencing handover once monitoring is attached (AN 15.02.12.12.30) and (RN 14.12.11.11.45); attaching monitoring together (RN 14.12.11.12.30) or someone else attaching the monitoring (RN 14.12.11.11.45). The attachment of monitoring along with the subsequent interpretation and administration of treatment was a high priority for nursing staff. The recovery nurses found that having a colleague with them to assist in connecting the monitoring or performing patient-focused tasks aided the handover (RN14.12.11.11.45). The recovery manager seemed particularly keen on this practice (RN15.12.11.16.15). This practice has two obvious drawbacks: increased resource and confusion on the part of the anaesthetist as to who was receiving the patient.

3.4.2.2.2 Previous studies

The pressure of providing care to satisfy patients' immediate needs versus participating in handover for their ongoing care is mirrored in the handover between paramedics and hospital doctors. Paramedics were required to repeat their handover on numerous occasions as the receiving team were distracted by providing care to their new patients (120). Paramedics described the importance of retaining the *'upper hand'* in the handover process by keeping the patient on their trolley and felt that once the patient had been physically transferred to a hospital bed they were no longer listened to (120). In another study of transfers between A&E and ITU a nurse commented '*If it is very rushed and there is nobody around and you are trying to attach a patient to a monitor plus trying to half hear half a handover - there are distractions that will influence it*'. (ICU-2-2)' (124). One A&E nurse highlighted the issue of concentrating on the handover whilst still caring for the patient and suggested the same work around which the recovery nurse manager had recommended to her staff here: *'(…) it would be good if there were two people there at the bed space, two intensive care staff, one to actually sort the machines out and one to take the handover'* (ED-FG-B) (124). This hubbub of interference in the safe delivery of patient care was described in the handover of patients in intensive care. Here the handovers were frequently disturbed in a similar fashion to those described by the post-operative handover team (155).

3.4.2.3 Transfer

3.4.2.3.1 This study

There seemed to be good agreement among all three professional groups with regards to the importance of the order of information. Both the surgeons and anaesthetists felt that the important information should 'book-end' the handover (S 21.12.11.10.30) and (AN 31.01.12.15.00). One likened the handover as the generation game, whereby contestants

seemed to remember the first and last prizes on the conveyer belt (S 06.02.12.12.10). The recovery nurses felt that ordered logical information improved recall.

With regards to specific ordering systems, several were suggested including: head to toe (RN 15.12.11.16.15) (RN 06.01.12.12.00); ABCDE (RN 21.12.11.18.00) (RN 09.01.12.11.45); highlighting the unusual areas in the history first (RN 20.12.11 18:00) or a structured checklist akin to the WHO surgical safety checklist (S21.12.11.10.30). When the interviewees were asked to order the information points, there appeared to be good concordance across the professional groups, with the first information point in the patient demographic group, followed by surgical then anaesthetic and past history.

The transfer of information appeared to represent a focus for inter-professional strain. When nurses complained about the quality of the post-operative handover, they were quickly chastised '*you are not a doctor, who are you to say?'* (RN15.12.11.16.15). However they defended their stance as there were occasions when the supporting documentation was incomplete or missing (RN15.12.11.16.15). This recovery nurse was not alone in commenting upon the quality of the post-operative handover. There were examples given within three of the interviews outlining examples of scant handovers. One of the recovery nurses reflected that the reason for this may be due to the longstanding relationship between them and the anaesthetist (RN14.12.11.11.45). Indeed, 'knowing' the recovery nurse seemed to be highly valued amongst the anaesthetists (AN15.12.11.14.25) (AN 02.02.15.15) (AN 08.02.12.15.40). This, they said, gave them permission to cut corners, however one of the anaesthetists reflected, *'I suppose to do it properly I should be doing it the same in every single instance'* (AN 08.02.12.15.40).

3.4.2.3.2 Previous studies

The theory of recall was tested in nursing shift handover by comparing both structured (consistent) and unstructured (inconsistent) information transfer (276). This theory relies

upon ‘schema theory’ whereby information transferred in nests of related information is more likely to be recalled than non-linked information. They found a positive correlation between structured handover and improved information recording and recall (276). They also found that only 50% of all transferred information points were recorded for future reference by the oncoming nurse, suggesting an element of data editing (276).

3.4.3 Limitations of findings

This interview study set out to examine the prevalence of inter-professional differences and challenges within the post-operative handover. The interviews were conducted at a small orthopaedic hospital, however the questions were generated to encourage to consider the post-operative handover in general terms, rather than focused on one group of clinical conditions.

Three professional stakeholder groups were included in the semi-structured interview and comparative interview studies. These groups were selected (surgeons, anaesthetist and recovery nurses) as they were seen to be the most directly involved and therefore influential in the process. It may be, however, that there exist a body of less-visible stakeholders which were excluded from the interview process. These could include other frontline staff such as theatre nurses, or higher level management as they have influence on list scheduling and therefore impact upon the time pressure of the operating list and handover.

Semi-structured interviews were analysed using grounded theory as it was thought to reduce bias in the coding analysis. It may have however been more fruitful to utilise framework analysis as the study could have been analysed using matrices to enable analysis of both themes and inter-professional differences. Upon reflection, this analytical approach may have provided a richer output from the interview analysis, however it is

thought that the analysis undertaken still represents an accurate reflection of the interviews collective meaning.

Another weakness is the lack of inter-rater reliability testing. As a result of this it is not possible to assess the consensus of the study's findings. This does therefore weaken the results of the interview study. It would be preferable to code the interviews with another researcher to ensure that the coding accurately reflects the interviews sentiment.

Future studies may consider interviewing the subsequent recipients of the post-operative handover: ward nurses and doctors. It would be interesting to investigate the 'Chinese whisper' influence on the post-operative handover and how the down-stream users gather information following an operation (171)

4 Comparative interview study between post-operative handover recommendations and frontline staff

4.1 Aims

Many recommendations exist, both from professional bodies and published in the peer-reviewed literature as to how best to optimise the post-operative handover. These recommendations have been made from utilising episodes of what could be considered to be best practice or developed from interview studies. However, a feedback loop between these recommendations and frontline staff opinion has not been made, leaving the possibility that omissions or misunderstandings could exist. Therefore in order to add a richer context to the comparison, qualitative analysis and quotes will be used to demonstrate the context and importance to the interviewee of the question.

The study aim was to establish the desired attributes of a successful post-operative handover, namely information transfer and rules. A secondary aim was to discover whether concordance existed amongst the interviewees as to the optimal order of information transfer. It was hypothesised that at this unique inter-professional handover there may be differences seen between the professional groups of anaesthetists, surgeons and recovery nurses.

4.2 Methods

This study was undertaken within the semi-structured interview study (Chapter 3). The study focused on two specific points of the post-operative handover: the information considered essential for safe transfer and ground rules to aid this process. As this study focuses upon fine detail of information handover, it was thought to be important to reduce

the risk of memory bias. It is known that at times of stress, abilities of recall are reduced (277) and that interviewees can suffer from 'stage fright' (109, 261). The interviewees may have memory failure in a number of ways: encoding - in other words not 'recording' an event at the time; distortion - altering the facts following the event; recall failure - forgetting and reconstruction, missing details (278).

Another challenge was the integration of pre-existing knowledge and recommendations from handover guidelines and literature. The interviewees are in a prime position to pass comment upon the published literature and professional body recommendations. It was thought that prior knowledge and recommendations could be condensed and presented to the interviewees for their review and comment. By producing a list of recommended guidance it was thought this would enable the interviewee to comment on prior findings as well as neutralising the effect of forgetfulness.

The interview was structured in a step-wise fashion, whereby the interviewees were first asked to list information without prompts or background information, and then to repeat the exercise utilising a list drawn from published guidance. The questions relating to this study were placed directly after the corresponding questions in the semi-structured interview study. This ensured that the interviewees were not swayed by the presentation of previous research findings but felt free to give their own professional opinion prior to making comment on others' work.

The questions were as follows: 'What information points do you consider to be essential for all recovering patients?'; 'Is there anything from this list which you would like to add to your suggestions?'; 'If you were to define some ground rules to ensure a safe post-operative handover what would they be?' and 'Like before, can you have a look at the list in front of you and highlight any rules which you consider to be important?'.

The list to which two of the questions refer is a summary of guidance and recommendations gleaned from published literature as well as medical institutional guidance (APPENDIX C) (Table 22 and Table 23). The interviewees were asked to review the recommendations and select what areas were pertinent to their treatment of patients.

A follow up question in the information transfer section asked the interviewees: 'How important is the order in which information is handed over?' and 'If you were to order the list of essential handover information which you created above, how would you go about it?'

This provided the opportunity for the interviewees to consider what structure should be formed around the information points. When this exercise had been concluded the interviewees were asked how many information points they could remember. 'How many information points do you think can be realistically remembered following a verbal post-operative handover?' The reasoning behind this was that there was an expectation that most of the interviewees would select a large number of information points which would be impractical. It was thought that by directly asking interviewees to consider this issue of memory recall, they may reflect upon the challenge in comparing what they would ideally like to know with what was practical to remember and recall.

4.2.1 Utilisation of pre-existing recommendations

4.2.1.1 Literature search

Handover information points and recommended rules from referenced guidelines were harvested, tabulated and summarised. A literature review was performed to capture literature, guidelines and recommendations in relation to the content and rules relating to medical handover. Search engines Google Scholar and PubMed were searched as well as the publications of the UK Royal Colleges of Physicians, Surgeons, Anaesthetists and the

General Medical Council. The published literature was searched in October 2011 and studies were included if they provided a rationale for recommending handover information transfer or rule. Included papers bibliographies were searched for suitable references. The studies could be from any hospital discipline (medical, surgical or paediatric) transferring patients within the hospital (e.g. shift handover, inter-speciality handover). Recommendations from the following guidelines and articles harvested and a list of handover information points and rules were produced (APPENDIX C) (Table 22 and Table 23) (64, 68, 123, 151, 157, 251, 279-282). The information was collated with an expansive view – with an information point or rules requiring just one reference to be included in the list.

4.2.2 Analysis technique

This structured element of the interview study was analysed using quantitative methods. This was felt to be appropriate given the aim was to provide quantification as to what information content was thought to be essential for safe handover as well as what rules may be of benefit. It would also enable collation of recommendations along professional lines and to explore the existence of inter-professional similarities and differences.

There were two main data sources for the analysis; the list of information and rules which the interviewees volunteered without prompting, and the selected list of information and rules which were presented to them. The anonymised data were transcribed from the interview recording and copied in to a spreadsheet. This was then used to interrogate the data to explore the recommendations made by each professional group (recovery nurses, consultant surgeons and consultant anaesthetists).

Prior to analysis, the data were cleaned as interviewees did not respond to either the information content or the rules questions with answers which were exactly the same as the recommendations from the literature. The data cleaning was performed in a sensitive

way to ensure that no loss of meaning occurred. Examples include: *'how they are recovering from the anaesthetic'* changed to *'what to expect in recovery'* (S06.01.12.11.00).

Following comprehensive data cleaning, the individual information points were further categorised in to corresponding super-categories (APPENDIX C) (Table 24). The super-categories were formed by grouping related points together. The purpose was to aid evaluation and visualisation of the data at different levels of granularity, with the super-categorisation providing clarity and the sub-categories detail.

The interviewees were asked if they wished to rank the information points in a transfer order. The interviewees were left to decide whether they wanted to group information points together or rank them as individual information points. Following the interviews, the ranking information was again transferred to a Microsoft Excel spreadsheet for analysis.

4.2.3 Statistical analysis

Differences in responses in the two states, spontaneous and post-introduction of the information sheet were tested using a split plot ANOVA. The test was performed for each professional group (anaesthetists, surgeons and recovery nurses).

Differences between the total number of information points initially requested and how many information points the professional groups (anaesthetists, surgeons and recovery nurses) thought they could remember were tested using a 2-tailed paired sample t-test. The size of the difference was quantified using a one way ANOVA.

Agreement between professional groups (anaesthetists, surgeons and recovery nurses) for requesting of each information handover category were tested using a one way ANOVA.

P values of <0.05 were considered to be statistically significant. All statistical analyses were carried out in SPSS v20.

4.2.4 Frequently associated information

To explore the relationship between discrete information points a visualisation technique was utilised to explore the inter-dependence of handover data. Hierarchical edge bundles are used to explore the relationships within and between large amounts of complex data. These categorical data visualisation tools are used to demonstrate linkages between categories in diverse industries including information technology and genomics (283). The purpose of hierarchical edge bundling is to simplify both parent-child (e.g. social network) and between-category (e.g. nature of association) relationships (283). These diagrams essentially aid the transformation of large volumes of unnavigable data into clear relational patterns which can be utilised to inform the development of novel associations.

The purpose of using this visualisation technique is to demonstrate common linkages between the super- and sub-categories of handover information points. It was thought that it would be of benefit to display the information in this manner to explore the relationship between discrete information points. These visualisations could also be used to compare differences between surgeons, anaesthetists and recovery nurses. The hierarchical edge bundles were produced using D3 library and open source code (https://bl.ocks.org/mbostock/7607999, accessed 06.01.17), they were designed by Mr Martin Robertson (Figure 19, Figure 20, Figure 21).

The principles of the diagrams are that each link relates to a response from an interviewee (i.e. one interviewee's response is represented as a continuous line which connects all of the information points which they requested). The thickness or concentration of the line demonstrates how often the information point has been requested.

4.3 Results

4.3.1 Information handover

As anticipated, the mean number of information points requested per interviewee increased following the introduction of the information sheet from 7.2 to 27.2, a fourfold increase. This was a statistically significant increase across all information categories (p= 0.004) and this was maintained when the discrete information points were grouped into their corresponding super-categories (APPENDIX D) (Table 24).

To test whether there was a difference in the change between the professional groups, a split plot ANOVA was performed to analyse the difference in the two conditions (284). There was no statistically significant difference found between the groups F(1 6, 7059.762) = 0.549 *p=0.08*.

4.3.1.1 Frequency of information point request

When the interviewees were asked to list what they considered to be core information points, only two points were stated by >50%: underlying medical disorders (84%) and operation (60%). In contrast, once the suggestions sheet had been handed to the interviewees, 28 information points were selected.

With the responses lumped in to the super-categories, it is possible to analyse inter-disciplinary differences. A one way ANOVA was utilised (285). This demonstrates a significant difference in the responses within the anaesthetic and surgical categories. It was found that the anaesthetists and recovery nurses requested more information points than the surgeons for the anaesthetic category. The anaesthetists and surgeons requested more surgical information than the recovery nurses (Table 10, Table 11).

Table 10 Super categories per discipline, total and adjusted to per-respondent

	Mean responses				p
	Anaesthetists	Recovery nurses	Surgeons	Total	
ABC	1.8	0.7	1.6	1.28	0.19
Anaesthetic	2.5	1.4	0.7	1.56	0.005
Documentation	0	0.7	1.2	0.6	0.17
Logistics	0.1	0	0.4	0.16	0.18
Medication	0.9	0.5	0.4	0.6	0.27
Monitoring	0	0.2	0.6	0.24	0.09
Past medical history	1.1	1.1	0.9	1.04	0.66
Patient demographics	0.6	0.5	0.1	0.44	0.47
Patient involvement	0	0	0	0	NA
Resuscitation	0	0.1	0	0.04	0.49
Surgical	1.3	0.6	2	1.2	0.05
Tasks	0	0	0	0	NA

Table 11 One-way ANOVA

ANOVA						
		Sum of Squares	df	Mean Square	F	p
ABC	Between Groups	5.726	2	2.863	1.783	0.192
	Within Groups	35.314	22	1.605		
	Total	41.040	24			
anaesthetic	Between Groups	12.331	2	6.166	6.841	0.005
	Within Groups	19.829	22	0.901		
	Total	32.160	24			
documentation	Between Groups	5.043	2	2.521	1.916	0.171
	Within Groups	28.957	22	1.316		
	Total	34.000	24			
logistics	Between Groups	0.771	2	0.385	1.847	0.181
	Within Groups	4.589	22	0.209		
	Total	5.360	24			
medication	Between Groups	0.911	2	0.455	1.413	0.265
	Within Groups	7.089	22	0.322		
	Total	8.000	24			
monitoring	Between Groups	1.246	2	0.623	2.578	0.099
	Within Groups	5.314	22	0.242		
	Total	6.560	24			
past medical history	Between Groups	0.328	2	0.164	0.418	0.664
	Within Groups	8.632	22	0.392		
	Total	8.960	24			

Demographics	Between Groups	0.928	2	0.464	0.771	0.474
	Within Groups	13.232	22	0.601		
	Total	14.160	24			
Involvement	Between Groups	0.000	2	0.000	NA	NA
	Within Groups	0.000	22	0.000		
	Total	0.000	24			
Resuscitation	Between Groups	0.060	2	0.030	0.733	0.492
	Within Groups	0.900	22	0.041		
	Total	0.960	24			
Surgical	Between Groups	8.100	2	4.050	3.440	0.050
	Within Groups	25.900	22	1.177		
	Total	34.000	24			
Tasks	Between Groups	0.000	2	0.000	NA	NA
	Within Groups	0.000	22	0.000		
	Total	0.000	24			

4.3.1.2 Hierarchical edge bundles

The diagrams below give an insight in to the groupings of information points by each professional group. Each line represents one interviewee's response with the thickness of the lines corresponding to greater number of responses.

The surgeons appeared to give the widest range of responses (Figure 19). The anaesthetists seemed to give the most conservative number of responses on a narrower range (Figure 21). They reported the widest responses on anaesthetic specific information. However they did not ask for any documentation or ongoing care recommendations. There were similarities in response frequencies between the surgeons and anaesthetists in the ABC

category. There were also similarities between the surgeons and recovery nurses in the ongoing care section as well as documentation. There was very little difference between the reported responses and prompt sheet responses. The recovery nurses and anaesthetists appear to show a degree of concordance. This may be due to their close working arrangement as they regularly interact at the post-operative handover. The surgeons gave the widest range of responses however they were the professional group which pointed to the importance of the post-operative care plan, an area which seemed to be universally omitted by both recovery nurses and anaesthetists. This may point to the focus of the post-operative handover being a mere transition point in the minds of the surgeons with their focus on the more distant patient discharge home.

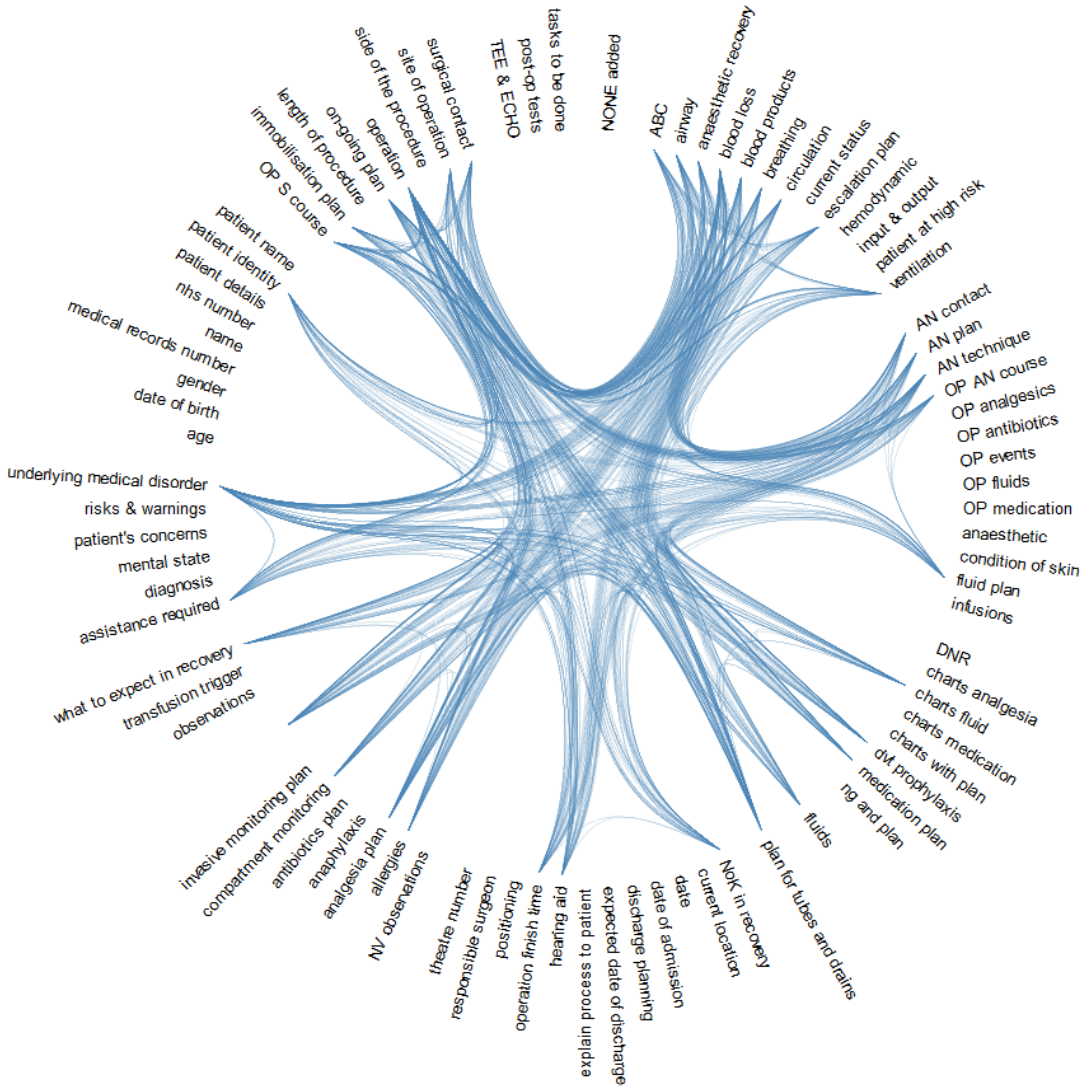

Figure 19 Surgeon statement hierarchical edge bundle, http://qif.io/eleanor/

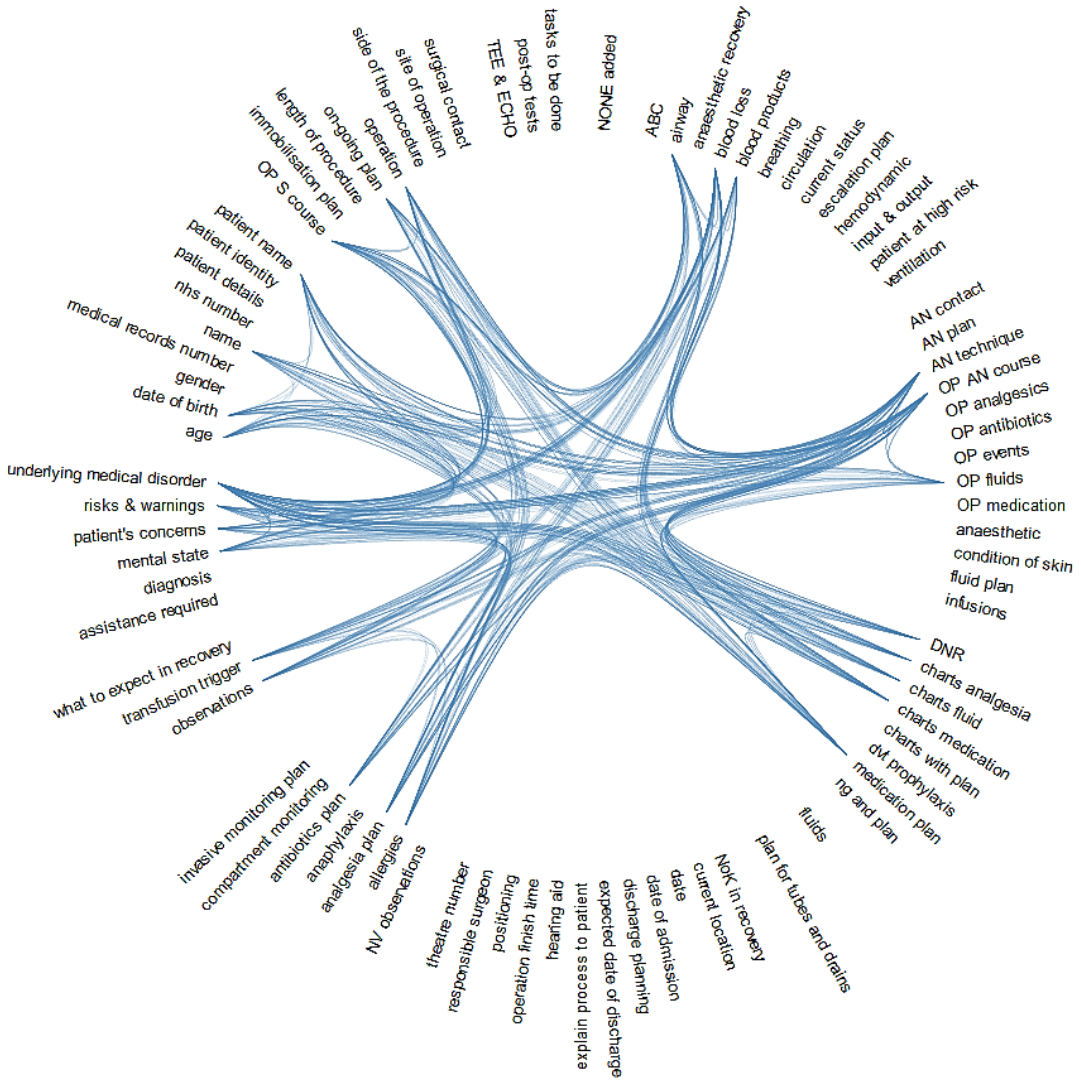

Figure 20 Recovery nurse statement hierarchical edge bundle, http://qif.io/eleanor/

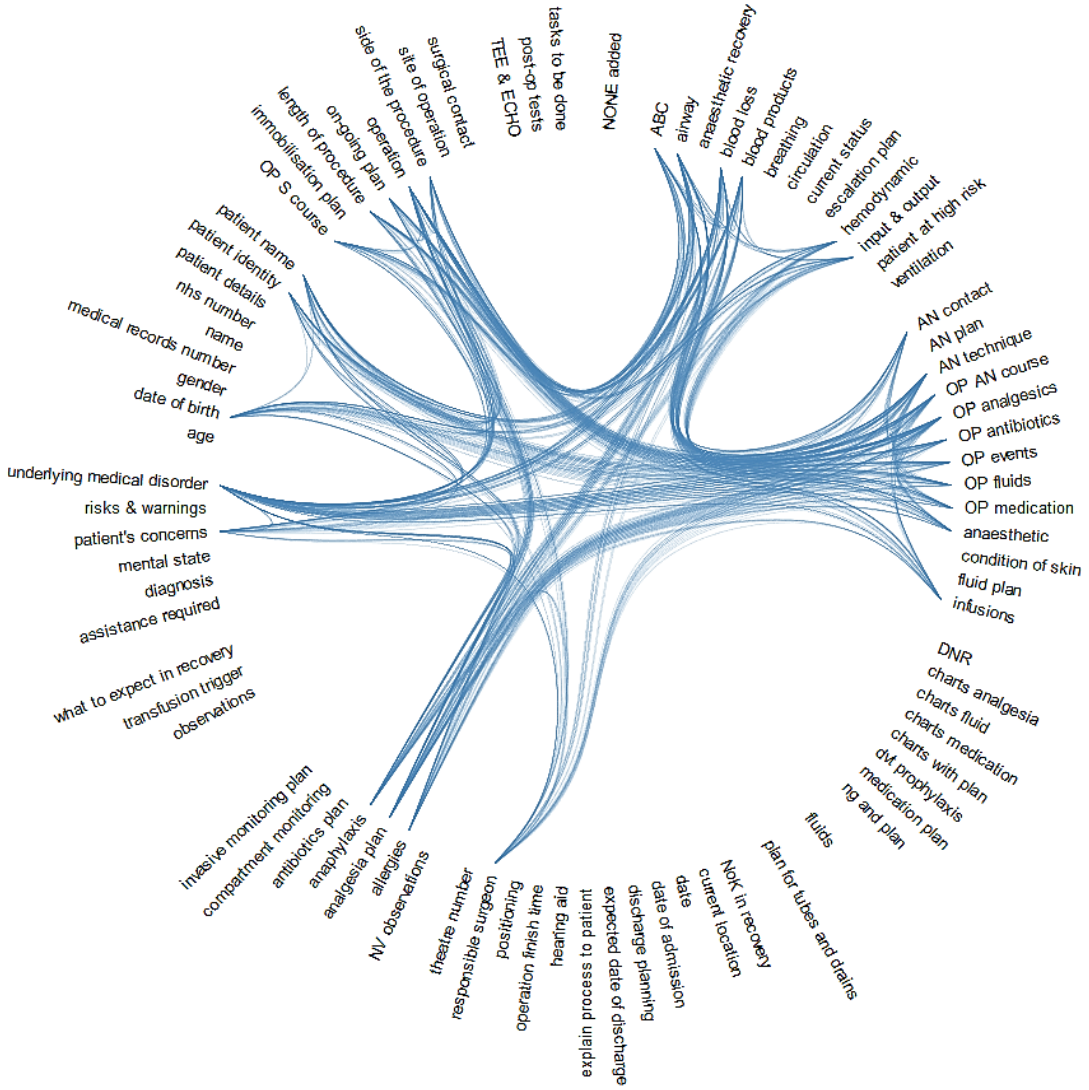

Figure 21 Anaesthetic statement hierarchical edge bundle, http://qif.io/eleanor/

4.3.2 Order of information handover

Respondents were asked to state the order in which information points should be transferred during the post-operative handover. Some interviewees chose to categorize their responses in groups. In this situation, all responses requested at rank position 1 were credited as being in this position; therefore there are more responses than interviewees in some rank positions.

In order to demonstrate the importance information order to the interviewees, the quantitative analysis of information order was supported and given richer meaning with a parallel qualitative analysis of pertinent comments from the interviewees.

4.3.2.1 Anaesthetic opinion:

Anaesthetists firmly believed that information order was important with 7 out of 8 stating they preferred structure. They linked structure with improved information recall: '*if you go through a systematic process then you can remember afterwards'* (AN 15.02.12.12.30). Two anaesthetists raised the point that important information should book-end the handover *'people tend to remember the first thing and the last thing you say more than the stuff in the middle'* (AN 31.01.12.15.00).

One anaesthetist commented *'it's maddening to receive a jumbled narrative'* (AN 07.12.11.16.40). Another linked clear structure with improved efficiency *'you would be able to actually make 6 – 8 points, it would be quicker and better understood and it could become a system'* (AN 15.12.11.14.25).

Two of the anaesthetists touched upon the importance of the environment, with one linking the busyness of activity distracting the receiving person from listening and removing clues from the sender as to their understanding. The other anaesthetist also shared that they were involved in stricter practices in other parts of the hospital whereby handovers in ITU (Intensive Treatment Unit) only occur once the critical tasks have been completed.

4.3.2.2 Recovery nurse opinion:

All of the recovery nurses believed that order was important. One of the recovery nurses linked good structure to a map; it enabled the listener to know where the handover was going (RN 14.12.11 12.30). This recovery nurse also felt that the structure could be unique to each anaesthetist *'this anaesthetists always starts off with…my airway breathing*

circulation, and this anaesthetist always starts off with name, date of birth, operation had, and that's fine, but it does need to be in some sort of logical order' (RN 14.12.11.12.30). They brought up their dislike of a jumbled handover *'it's no good jumping round, cause jumping round means that they forget things and we don't, erm understand the things and don't clue up to the importance of things so and a smooth order is important'* (RN 14.12.11 12.30).

Structure was thought to aid future recall of information, two of the recovery nurses found a 'head to toe' handover approach helpful (RN 15.12.11.16.15) (RN 06.01.12.12.00) whereas another two found an 'ABCDE' approach useful (RN 21.12.11.18.00) (RN 09.01.12.11.45). Another felt that important information should be prioritised in the handover and another found that specific highlighting of important information as well as clear task prioritisation very helpful (RN 20.12.11.18:00).

4.3.2.3 Surgeon's opinion

All of the surgeons believed that the order of information was critical to a good handover. Most felt that the most important information should be placed either at the beginning or the end of the handover. One of the interviewee's likened this reasoning to the generation game *'What was that competition, the television competition when they had the conveyer belt with prizes, the generation game, you always remember the first few and the last few but in the middle it would be hit and miss'.* (S 06.02.12.12.10)

Another felt that the post-operative handover could benefit from a similar layer of structure as the pre-operative briefing *'In the same way that you get a more formal order in the pre-operative briefing, just as an aide-memoire of things that you have got to think about I think it stops things being forgotten and also it gives a structure to it, so I think order is important.'* (S 21.12.11.10.30).

One surgeon felt that there should be special emphasis placed on unusual points for that patient '*Keep highlighting the things that you are concerned about, above what is 'normal' and done for all patients'* (S 22.02.12.08.40).

4.3.3 Rank of information points

A total of 58 information points were selected by the interviewees which represents 65.9% of the total number of information points previously selected. This finding is of interest in that it may represent a self-editing of total information points that should be handed over as by ranking them, an internal list is formed and obsolete items are therefore discarded. The initial round of analysis records the overall summary of responses at each handover rank position (Table 12). This table was constructed by recording the order in which the interviewees requested an information point. i.e. one respondent stated that the order of information transfer should be: patient name, date of birth, operation, allergies, intraoperative anaesthetic course and complications, infusions, blood loss, plan. Each of these information points would be given a rank position and demonstrated in the table below (Table 12).

Table 12 Rank of information points, all respondents (n=25)[2]

		Rank position														
	Subcategory	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ABC	Airway	2	4	0	4	0	1	1	0	0	0	0	0	0	0	0
	Blood loss	0	1	5	0	2	3	1	1	1	0	0	0	0	0	0
	Blood products	0	1	3	0	1	2	1	1	0	1	0	0	0	0	0
	Current status of patient	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	Escalation plan	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0
	Hemodynamic	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0
	Input & output	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0
	Patient at high risk	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0
	Ventilation	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0
anaesthetic	Anaesthetic technique	2	1	5	2	0	1	0	0	0	0	0	0	0	0	0
	Condition of skin	0	0	0	2	0	0	0	0	1	1	0	0	0	0	0
	Contact number of person in case of anaesthetic problem	0	0	1	2	1	0	1	0	0	1	1	0	0	0	0
	Infusions	0	1	0	1	2	2	1	1	0	0	0	0	0	0	0
	Intra-operative anaesthetic course & complications	2	3	6	3	2	1	0	0	0	0	0	0	0	0	0
	Intra-operative analgesics	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
documentation	Advanced directives & DNR	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0
	Charts analgesia	0	1	0	2	3	0	0	0	2	1	0	0	1	0	0
	Charts documentation of post-operative plan	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
	Charts fluid	0	1	0	4	1	0	0	1	1	0	0	0	0	1	0
	Charts medication	0	1	0	3	1	0	0	0	2	0	0	0	0	0	1
	Documentation of post-operative plan	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	DVT prophylaxis	0	0	0	2	0	0	1	1	1	1	0	0	0	0	0
	Medication plan, drugs to be re-started	0	0	1	2	1	0	1	0	1	0	0	0	1	0	0
	Plan for intravenous fluid	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0
	Plan for tubes and drains	0	0	1	2	1	1	0	1	1	0	0	0	0	0	0
logistics	Current location	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Date	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Date of admission	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Discharge & transfer planning	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	Expected date of discharge	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Explanation of the process to the patient	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Responsible consultant surgeon	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0
	Theatre number	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
medication	Allergies	0	2	1	4	1	0	0	0	1	1	1	0	0	0	0
	Analgesia plan	0	2	2	3	2	1	1	3	1	0	0	0	0	0	0
	Antibiotics plan	0	0	0	2	0	0	0	1	2	0	0	0	0	0	0
	Monitoring and range for physiological parameters e.g.	0	2	2	0	1	1	2	1	1	0	0	1	0	0	0
	Plan for continuous invasive monitoring	0	0	1	1	0	1	1	2	0	0	0	0	0	0	0
	What to expect in recovery	0	0	1	4	1	0	0	0	0	1	0	0	0	0	0
past medical history	Diagnosis	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0
	Mental state	2	0	0	1	0	0	0	1	0	0	0	0	0	0	0
	Risks & warnings	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
	Subjective information about the patient's concerns	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Underlying medical disorder	1	3	4	0	4	1	0	0	0	0	0	0	0	0	0
patient demographics	Date of birth	3	3	1	0	0	0	0	1	0	0	0	0	0	0	0
	Gender	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Medical records number	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Name	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NHS number	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Patient details	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Patient name	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
surgical	Contact number of person in case of surgical problems	0	0	1	1	1	2	0	0	0	0	1	0	0	0	0
	Intra-operative surgical course & complications	1	0	6	4	1	1	1	1	0	0	0	0	0	0	0
	On-going plan	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
	Operation	2	10	7	2	0	1	0	1	0	0	0	0	0	0	0
tasks	~~Post-operative investigations~~	0	0	0	1	0	1	1	0	0	1	0	0	0	0	0
	Tasks to be done	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0
	TEE & ECHO	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

[2] TEE: Transthoracic echocardiogram; ECHO: echocardiogram; DNR: do not resuscitate; ABC: airway breathing circulation

4.3.3.1 Super-category analysis

Upon grouping the information points in to their respective super-categories, it is possible to see the position of the information points with greater clarity (Figure 22).

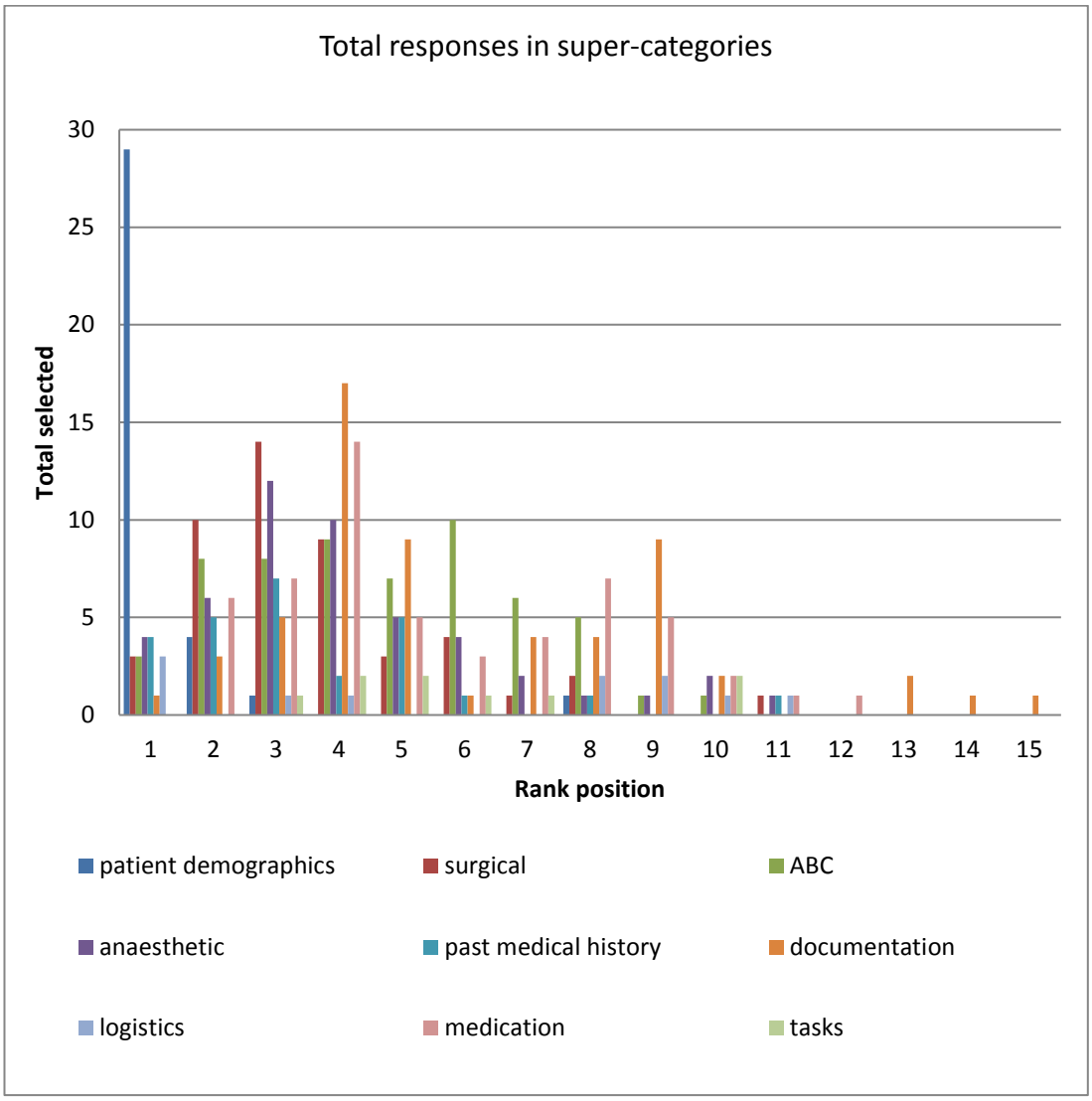

Figure 22 Total responses per super-categories (all respondents (n=25))

'Patient demographic' category was most frequently selected at rank position 1 (n=29). Indeed the highest rated response in the whole ranking exercise was the selection of 'patient name' (n=16) (Figure 23).

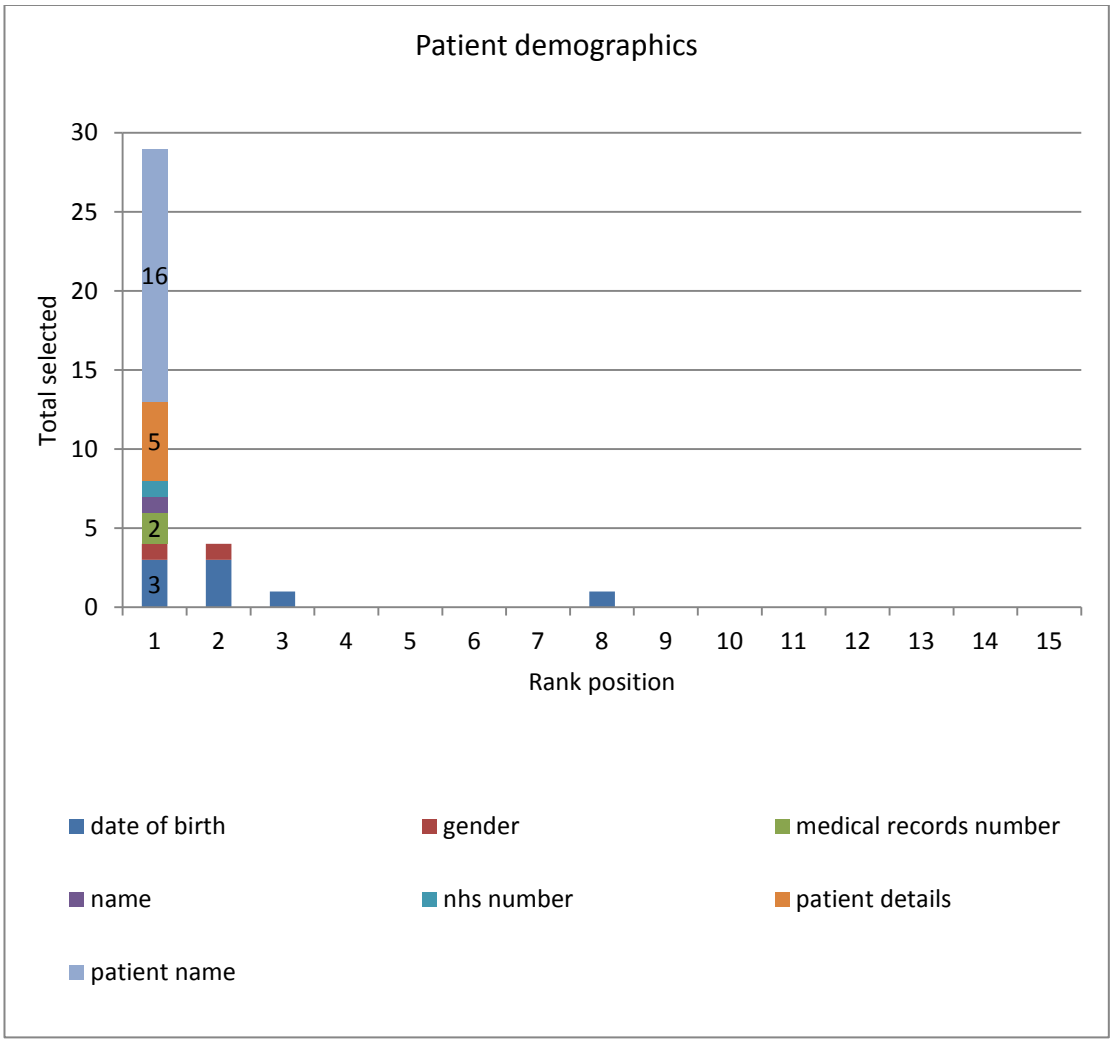

Figure 23 All utterances of patient demographic information, majority selected in rank 1

In the second rank position, the most commonly selected category was ‘surgical’ with the patient’s operation being selected the most by interviewees (n=10) (Figure 24). This category was also selected very frequently at the third information point (n=14).

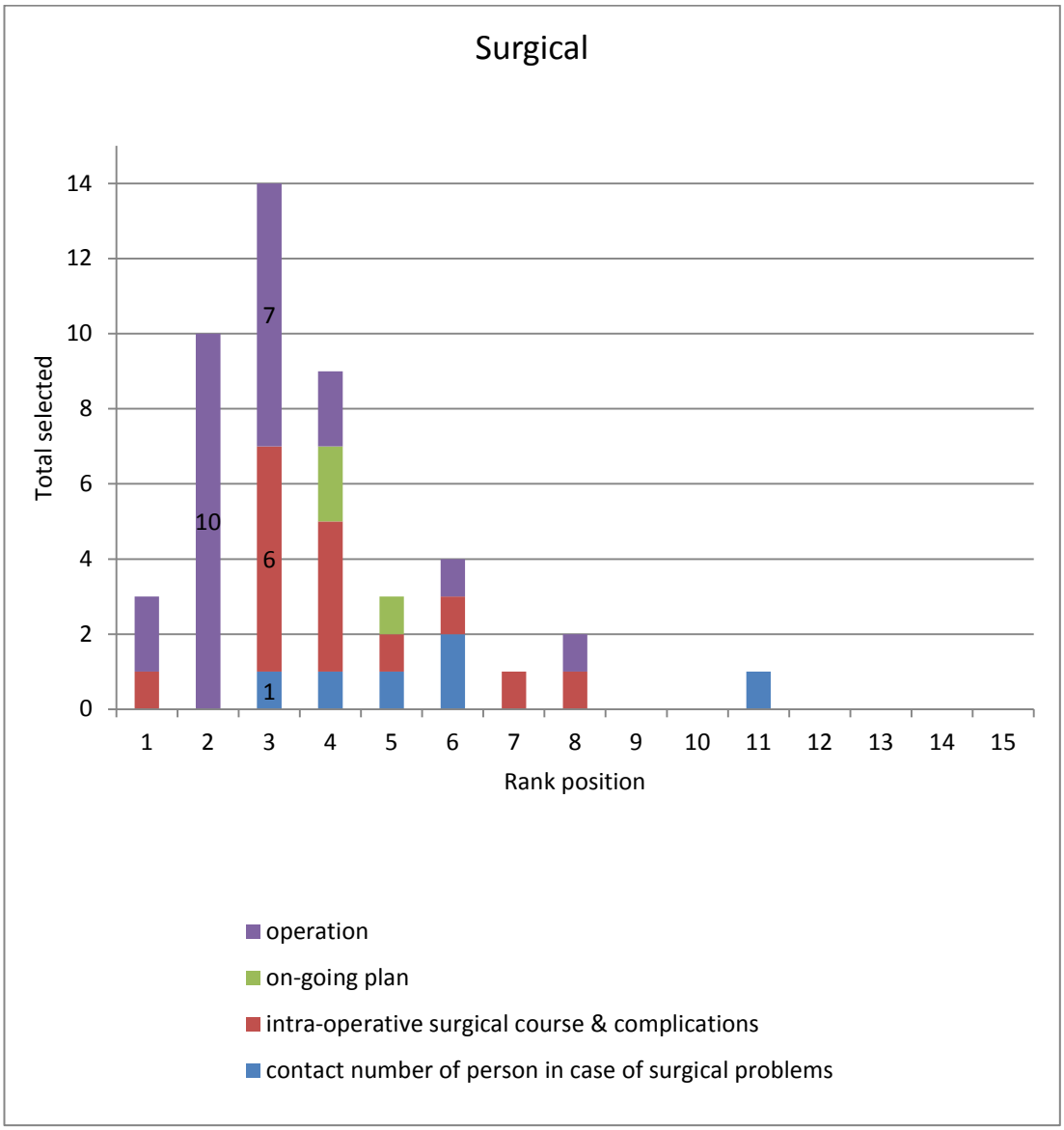

Figure 24 All utterances of surgical information, majority selected in rank 2 and 3

Within the third rank position, the anaesthetic category increased in frequency with 12 of the sub-categories being selected (Figure 25).

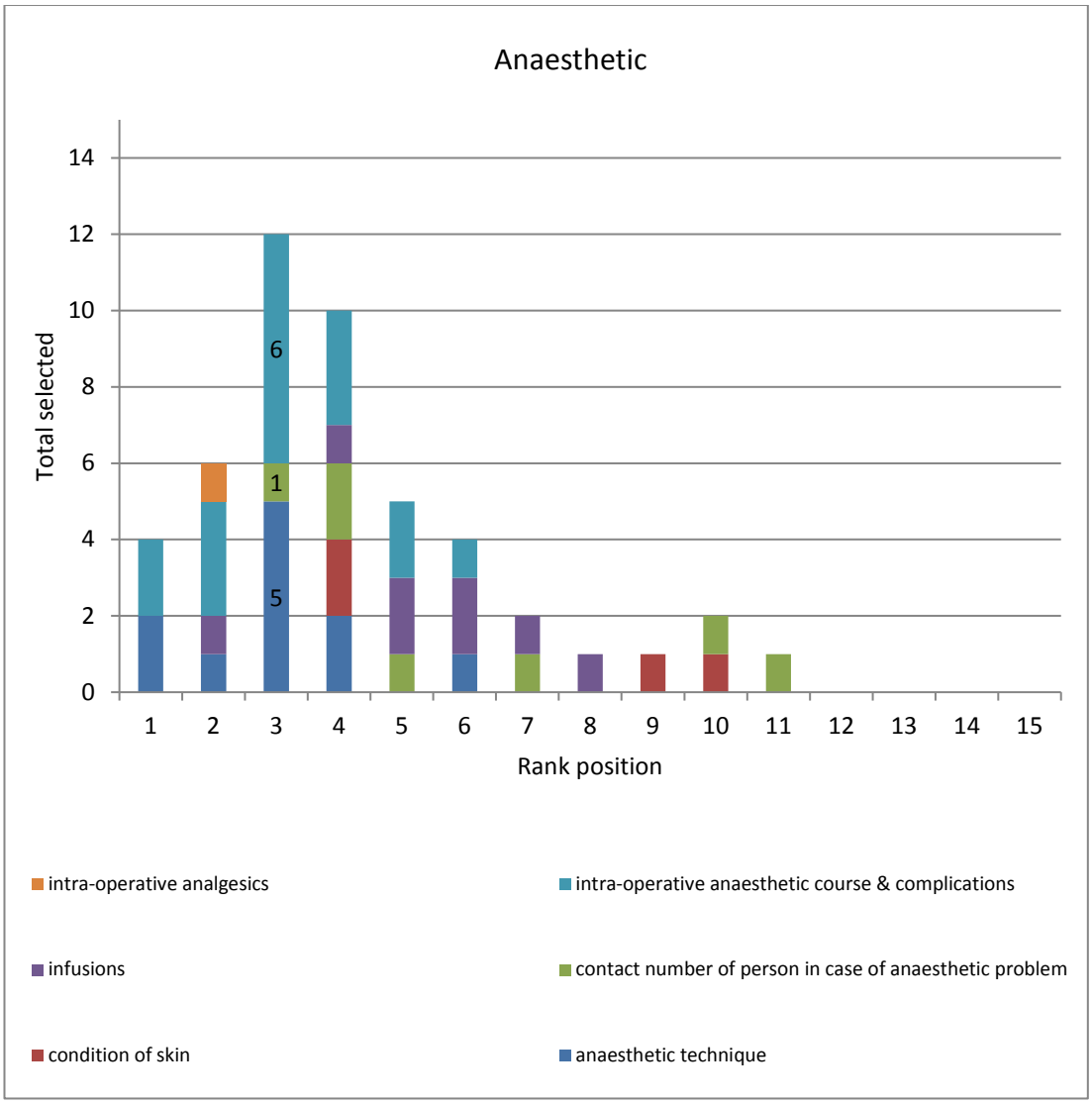

Figure 25 All utterances of anaesthetic information, majority selected in rank 3

The other category which shared the third position in ranking most frequently was past medical history (Figure 26).

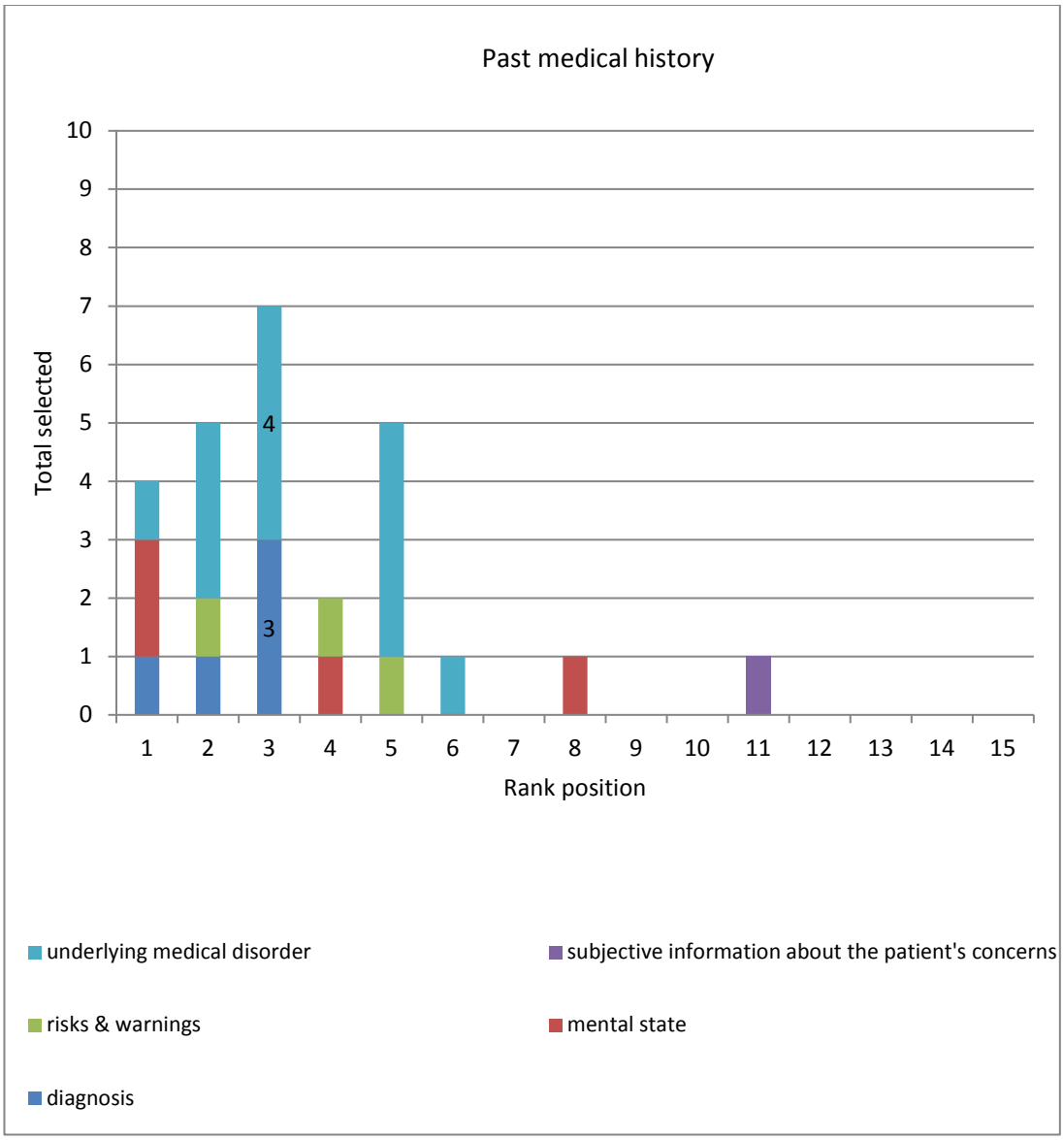

Figure 26 All utterances of past medical history, majority selected in rank 3

Once these core components were completed, there was not a strong correlation between category and rank position.

4.3.4 Memory and recall

The interviewees were asked how many information points they thought they could recall once they had completed the ranking of information. The interviewees tended to laugh at this question. One of the recovery nurses reflected *'remember? I would think 6 or 7. But I'm asking for a lot more aren't I?! It's weird isn't it?'* (RN23.12.11.11.45).

A recovery nurse felt that a structured handover and note-taking enhanced her ability to remember information *'so that you can prompt yourself again'* (RN14.12.11.12.30). A surgeon also felt that note taking augmented the verbal handover *'Five, unless it is written down, if it's written down then it's much larger'* (S21.12.11.10.30). An anaesthetist appreciated that *'people don't remember everything that you tell them so I will usually write the basics on my anaesthetic chart (…) so it is in two different places'* (AN06.02.12.16.15). Another reflected upon their practice and felt that the way in which they presented the information would either enable more recall or less (AN31.01.12.15.00). An anaesthetist felt the environment in which the handover was taking place would influence the handover *'in a situation which is realistically noisy and there are other issues then three is about the number of things that you can remember'* (AN31.01.12.15.00). They felt this was akin to '*football managers' half-time team-talk'* (AN31.01.12.15.00). One of the surgeons reflected upon the total workload which the recovery nurses were having to coordinate: *'if you are looking after five or six patients and you were told thirty things about all of them and it's not written down then the level of recall will be a lot less, it could be as little as two or three things'* (S21.12.11.13.07).

In answer to the question, how many information points do you think you could remember, the mean response was 7.4 points. There was no significant difference between the professional groups as to how many information points they thought they could remember ($p=0.2$). Eleven participants did not give an exact number, either they stated two e.g. four

or five (nine interviewees), or they said less than (two interviewees,<10). For these cases, the highest number was utilised for the analysis.

There was no significant difference between the total number of information points requested by the interviewees initially (total mean: 7.1 SD(3.3)) and how many they thought they could remember (total mean: 7.4 SD(3.5)), p=0.8. There was a highly significant difference between the respondents total number of information points highlighted (total mean: 27.5 SD(13.6))and the number of information points they thought they could remember(total mean: 7.4 SD(3.5)), p=<0.000. A one way ANOVA confirmed this finding with a significant Wilks' Lambda p=0.000 and a very large effect size Partial Eta Squared = 0.726 (286).

4.3.5 Rules for handover

The interviewees were asked if there were some 'unwritten rules' relating to the post-operative handover. Following this they were asked to recommend some rules before being shown a list of recommendations from other guidelines (APPENDIX C) (Table 23)

The 25 interviewees responded with a total of 65 rules. As with the information handover section, these spontaneously created suggestions had to be cleaned to enable analysis and five new categories were created to accommodate new themes, namely: people involved; monitoring; documentation; checklist and interpersonal. 60% of the respondents felt that the handover should be *'more structured'* (AN08.02.12.15:40) and have *'relevant information'* (AN25.01.16.12:50). 40% of respondents recommended that some form of task separation occurred during the handover *'someone else putting the monitoring on'* (AN25.01.12.08:50) or *'separate tasks from handover'* (AN15.02.12.12:30).

When the interviewees were shown the list of recommendations, the 25 interviewees selected a total of 208 rules, mean response of 8.32 rules per respondent (AN=9.125,

RN=8.7, S=6.85). The anaesthetists selected the most rules, (mean of 8.7 per interviewee), followed by recovery nurses (mean of 8.3 per interviewee) then surgeons (mean of 6.7 per interviewee). The ranking of rules is shown below (Figure 27)

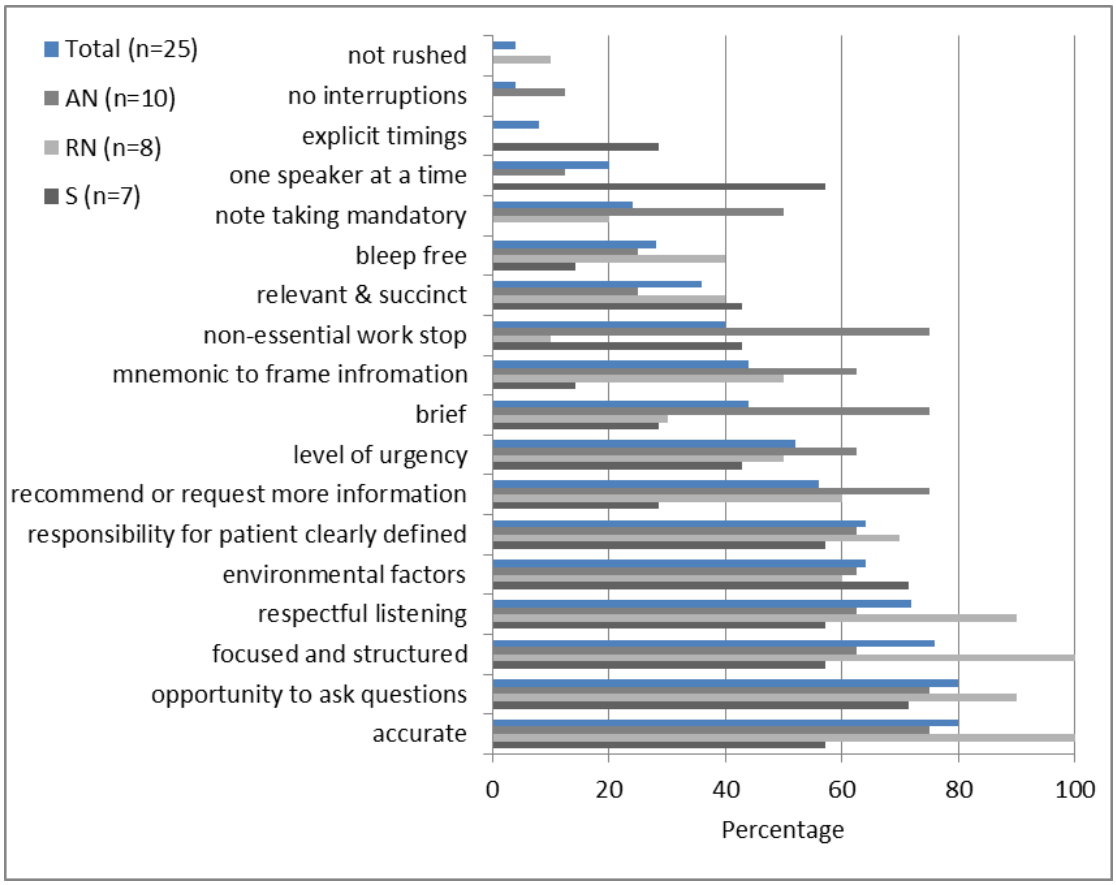

Figure 27 Highlighted rules, all staff

The most frequently selected rules were ‘accurate’ and ‘opportunity to ask questions’, closely followed by ‘focused and structured’ and ‘respectful listening’. The next most frequently requested rules were relating to ‘environmental factors’ and that ‘responsibility for patient clearly defined’. Interviewees rarely chose the category of ‘bleep free’ or ‘no interruptions’ as they stated that this would be very difficult in the environment.

4.4 Discussion

This study shows good concordance between the professional groups. All of the groups increased the number of handover information points as well as rules once they were shown the list of published recommendations.

4.4.1 Order of information

There was concordance both within and between professional groups that clear structure aids both the efficiency and reliability of the handover. The recovery nurses did not seem to mind what the order was but appreciated when a handover was provided in a clear way, with one nurse relating this to a map and another to ABCD (airway, breathing, circulation, disability). The anaesthetists felt that it was important to relate significant information at either the beginning or the end of the handover. The surgeons agreed with this sentiment as they felt that this increased the likelihood of those particular information points being remembered. There seemed to be some support for the handover to become more structured and standardised, like a checklist.

The order of information at handover has been considered by other studies, with one in particular introducing an information handover checklist which was shown to reduce the mean number of information omissions from 2 to 1 per handover (151). Another study evaluating the post-paediatric cardiac surgery handover found that by introducing a protocol for the handover, omissions were significantly reduced from 6.3 to 2.3 per handover (153).

4.4.2 Memory and recall

All of the interviewees reflected that they would not be able to recall the entire list of information points they requested, with there being no significant difference in the number they originally stated and how many they felt they could recall. Of interest, the mean

number which the interviewees felt they could recall was 7. It has long been accepted that the number of discrete points a person can recall is 7 +/- 2 (244), although this has more recently been decreased to 4 (287). Memory has been considered in three distinct components: sensory, short and long term memory (288). Sensory memory is captured within a second and tends to relate to sensory experience. Short term memory is what relates to the 7+/-2 hypothesis and can last up to 18 seconds. Long term memory is of unlimited duration but it is hypothesised that the connections which permit retrieval may be broken after a length of time (288). The memory component which will be most frequently utilised within the post-operative handover is the short term memory. Although the handover generally requires more than 18 seconds to complete, the clinician receiving the information will immediately need to utilise the information and therefore is unlikely to be consigned to long-term memory. A more fitting descriptor could be working memory, although the author did conclude that there may not be such a difference between these concepts, more of a disagreement on terminology (289).

4.4.3 Rules for handover

Like the order of information handover, there seemed to be good alignment between the professional groups as to what ground rules should be enacted during the post-operative handover. The most frequently selected ones (accurate, opportunity to ask questions, respectful listening and focused and structured) seemed to surround the act of information transfer itself rather than looking beyond it as an act of communication.

4.4.4 Strengths and weaknesses

This study set out to verify and rationalise published literature recommendations with post-operative handover stakeholders. This approach seems to be unique in the literature. This novel approach attempted to put the interviewees in to an advantageous position by making lists of pertinent information points available to them. It was thought that this

would neutralise the ‘stage fright’ effect from the interview. There are caveats to this method. The first could conceivably be due to omission of pertinent handover information points or rules. The second would be to imply to the interviewee that their efforts within the interview study were of limited value as the area had been explored in depth in the past. The study set out to overcome both of these biases by performing a wide search for guidance as well as phrasing the question in such a way as to encourage the interviewees to comment on the past research rather than to compare their opinion or responses with a ‘gold standard’.

5 Intervention study

5.1 Aim

There have been attempts to improve the reliability of the post-operative handover and these often come in the form of a protocol or checklist (151, 153, 156). These interventions were undertaken in specialist areas including paediatric cardiac surgery and general surgery. It was thought that there may yet be benefit in creating a novel handover intervention which could be transferred from one specialist environment, in this case orthopaedic and plastic surgery, to other clinical areas.

The aim of this study was to introduce an evidence-based quality improvement intervention in the post-operative handover and evaluate the effectiveness in terms of information transfer quality.

5.2 Methods

The study was designed using a pre-intervention, intervention and post-intervention phase design. It is true that the study design could be strengthened by changing to a stepped-wedged or through the introduction of randomisation, due to constraints on both time and study environments the pre/post intervention evaluation was thought to be the most practical. It should also be noted that all previous studies in this area had utilised this study design framework. Indeed, this smaller-scale feasibility study would generate sufficient information to gather whether the intervention has the desired effect.

Observations, document analysis and surveys were conducted during pre- and post-intervention phases for the purpose of evaluation. These three different measures were chosen as together they would provide a more thorough evaluation of the handover process, than any single one alone.

5.2.1 Demographics

The handover observations were undertaken within the Nuffield Orthopaedic Centre (NOC), Oxford University Hospitals NHS Trust. The observations were undertaken in two tranches, with pre-intervention observations occurring between 18.10.11 - 28.11.11 and post-intervention between 20.05.12 – 23.07.13. The first round of observations coincided with the intra-operative data collection for the Safer Delivery of Surgical Services quality improvement study (290). This required the observation of intra-operative processes from patient entry to exit (291-293). The assessment of the post-operative handover was therefore a natural extension of the pre-existing observation process. All participants gave written, informed consent to observation of the operative and post-operative events.

5.2.1.1 Numbers observed

A total of 34 operations and post-operative handovers were observed in the pre-intervention period and 11 operations and post-operative handovers were observed in the post-intervention period. There were 26 orthopaedic procedures and 8 plastic surgical procedures in the pre-intervention period. There were 8 orthopaedic and 3 plastic surgical procedures in the post-intervention period. There were a total of 13 different anaesthetists involved in the pre-intervention handover (max per 5 observations per-anaesthetist) and a total of 4 anaesthetists involved in the post-intervention handover (max 4 observations per anaesthetist). The procedures were selected using a convenience sample with pre-defined characteristics. Operating lists were targeted for observation if they contained a high proportion of pre-selected procedures: orthopaedic (primary and revision hip and knee arthroplasty and arthroscopic procedures) and plastic surgery (excision of benign and malignant lesions with various reconstructive techniques including free flaps) (291).

The operations took from between 48 minutes and 13 hours 30 minutes with a mean of 2 hours 25 minutes in the pre-intervention period. The operations took from between 16

minutes and 2 hours 50 minutes with a mean of 1 hour 38 minutes in the post-intervention period.

5.2.2 The intervention

The TIDieR reporting checklist was utilised to frame the reporting of this quality improvement intervention (208). The 12-point checklist aims to encourage standardised reporting of quality improvement interventions to enable comparison as well as replication in related environments.

The intervention was introduced to the recovery and theatre teams as the 'post-operative handover project'. The project was set up with an aim of producing a more reliable, standardised post-operative handover. The intervention would be informed from the published literature and the on-site interview study to inform the final product. To aid quick acceptance and integration of the new work pattern, frontline staff would be invited to be involved in all aspects of the interventions' development and deployment. In order to facilitate this, multiple one on one impromptu meetings were undertaken with recovery nurses, surgeons and anaesthetists. The findings from the interview study and observations were reflected back to them and a discussion was encouraged as how to best improve the transfer of care in an acceptable fashion. Information about the project's development was shared with all involved parties using multiple dissemination methods. These included: face to face meetings with anaesthetists and recovery nurses (April – May 2012); project update newsletters (April – May 2012); emails and presentations to recovery nurses and at Nuffield Department of Anaesthesia grand rounds (July 2012) (see APPENDIX E for copies of all). The educational content covered patient safety history and the inherent risks of handover.

The aim of the intervention was to separate the physical and information handover. The rationale behind this decision was to reduce multitasking during the crucial information transfer in order to increase the likelihood of information retention. In order to achieve

this, the handover was separated in to different phases. Phase 1 attachment of monitoring and assessment of the patient's airway and breathing. Phase 2 comprehensive handover of the patient's details, their past medical history and allergies, the intra-operative surgical and anaesthetic course and post-operative management plan. It was suggested that the anaesthetist and recovery nurse referred to the relevant charting during this phase: i.e. the anaesthetic and medication chart, to act as a prompt to the conversation as well as ensuring that post-operative medication was prescribed. Phase 3 encouraged questions from the recovery nurse to the out-going anaesthetist as well as establishing where the anaesthetist was planning on going to should any issues arise. Phase 4 was designed to aid transition to the ward, encouraging a handover of DVT prophylaxis, mobilisation plan as well as estimated date of discharge.

All of the content of the intervention was designed and delivered by ER. Once the handover phases had been created, an A3 laminated printout of the handover protocol was placed above each bed space in recovery (Figure 28). In addition to the placement of the protocol, ER was available during the first few weeks to discuss the intervention on an ad-hoc basis with theatre and recovery teams.

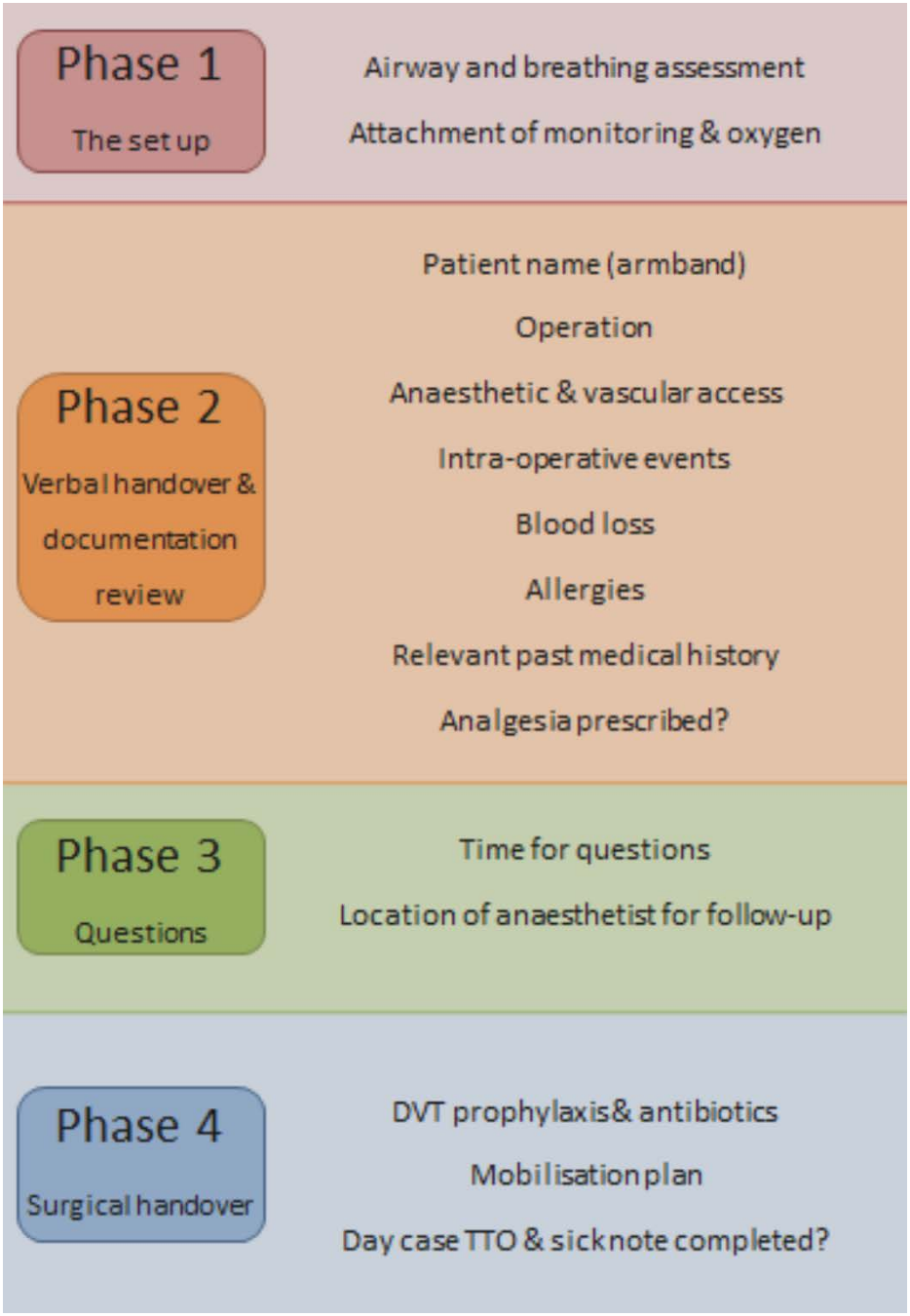

Figure 28 Handover protocol

It was intended that the intervention would be personalised to the local environment. The personalisation would be fashioned in two ways. The first would be the application of

knowledge from the interview study, the second was through encouraging the frontline staff to contribute to the format and introduction time-frame of the intervention.

It was thought important to profit from knowledge from the interview study as an in-depth understanding of the micro and meso system had been gained by it. Specifically, the interview study afforded time for the interviewer to build working relationships with key operators within the theatre environment. The interview process in itself requires trust on behalf of both parties and it was appreciated that this would have some impact upon the likely success of any subsequent improvement intervention. It was hypothesised that as a significant proportion of the recovery team (including the manager) as well as senior anaesthetists and surgeons took part in the interview study, they would be more likely to support and maintain a subsequent relevant intervention.

In addition to the information gleaned from the interview study, the intervention used non-tailored principles from the published literature. The evidence for this was formally assessed during the systematic literature review process (158).

The adherence of the recovery team to the intervention was observed during the planned post-intervention intervention phase by one observer (ER) who observed the pre-intervention base-state and worked alongside the staff in introducing the intervention.

5.2.3 Ethics

The study received ethical approval from (Oxford A REC 09/H0604/39). Hospital management and all theatre staff were fully informed of the study and consented to take part during the observation period.

5.2.4 Observation

5.2.4.1 Intra-operative evaluation

Prior to the post-operative handover, the entire operation was observed by two observers, one surgical trainee and one human factors researcher. The intra-operative process was being observed as part of a study evaluating the role of improvement interventions in the provision of safe surgical care (158, 246, 290, 294). The observations commenced from the time the patient was brought into the operating theatre to after the completion of the post-operative handover. It was the practice in this particular hospital for patients to be anaesthetised in the anaesthetic room prior to being brought in to the operating theatre and transferred on to the operating table. The observations included an assessment of the team's non-technical skills (158), process measures (292) and the quality of the WHO surgical safety checklist (293). The observers were well established within the operating department and prior agreement from the hospital management as well as consent from staff being observed was sought before the observations began (295).

The structured data collection aimed to inform the observer of the handover as to the accuracy of the information transferred at the handover. During the operation, information was gathered by document analysis, observing, questioning or listening to structured information transfers (Figure 29).

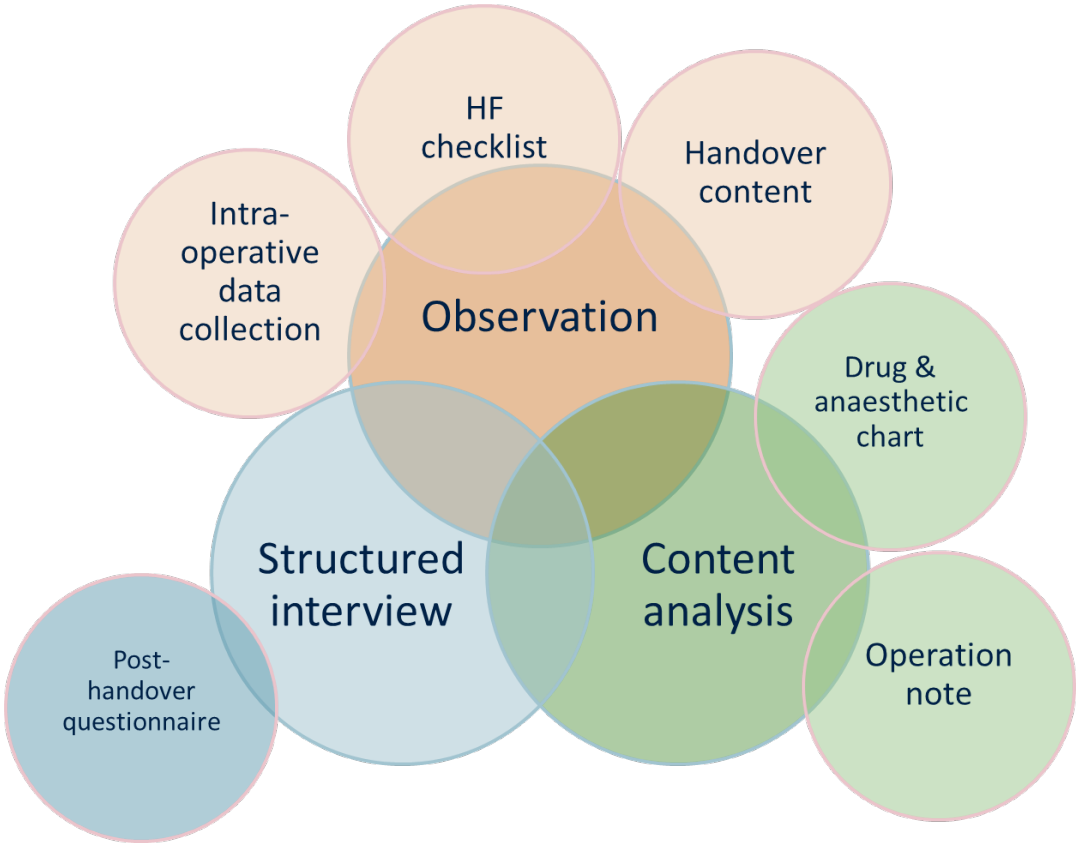

Figure 29 Package of handover assessment

In the operating theatre, patient specific data act as aide-memoirs throughout the operation (i.e. recording the number of swabs in the operative field) and can hold significant information about the patient such as allergies. These data were collected in a systematic fashion throughout the operation. The content of the surgical safety checklist was recorded, with patient specific information such as: name, age and date of birth, being recorded as part of this. The unique point from the WHO surgical safety checklist was the administration of i.v. antibiotics (Table 13).

Table 13 Intra-operative data collection, ticks correlate with opportunities[3]

	Observation	Staff interview	WHO surgical safety checklist
Name, age, DOB		√	
Allergies		√	
PMH	√		
Anaesthetic			√
Intraoperative events			√
Operation performed		√	√
Intraoperative blood loss	√		√
Drains		√	√
Intraoperative antibiotics	√	√	
DVT prophylaxis		√	√
Discharge planning	√		√

Structured intra-operative data collection focused upon collecting accurate information from source material on key handover points. The selected points were taken from the interview study as well as pre-existing recommendations (54, 279).

5.2.4.2 Handover observation

The post-operative handover was observed by a single observer (ER). The patient was followed from the operating theatre to the theatre recovery and observations of the operative progress and intra-operative events were continuous throughout this. The observer stayed within listening distance of conversations and recorded key episodes of information transfer between the anaesthetist and recovery nurse. The name of the anaesthetist and recovery nurse was not recorded. The reason for this was that the locus of

[3] DOB: Date of Birth; PMH: Past Medical History

the intervention was the whole of the recovery setting rather than on particular members of staff. The lack of name recording also gave assurance to the nursing and medical staff that they were not being 'scored' on their performance. The disadvantage of course is that it is not possible to be certain as to whether the pre- and post-intervention recordings were taken from a similar pool of staff members (i.e. if there had been a significant staff turnover between recordings) however this was thought to be unlikely.

During the post-operative handover, the process was observed within its natural context rather than in a staged or simulated environment. The effect of the 'environment' upon the handover was therefore recorded in a systematic but open fashion. The data collection was based on methods which effectively transform what can be a chaotic set of occurrences into coded instances (151, 155, 292). The recording of these occurrences started upon arriving in the recovery suite and finished when the anaesthetist left the patient's bedside. They can be considered within three broad categories: background noise; interruptions and concurrent tasks. A code of background noise was recorded if the observer/listener (ER) became aware of a higher than normal level of noise activity which caused an interruption in the handover. The observation checklist was developed using previously recorded distractions and aided standardised observation (155). Individual descriptors were placed within three overarching categories: background noise (external noises: telephone, other patient noises); process interruption (handover interrupted: e.g. other staff members, patient wakes, looking for notes) and concurrent tasks (e.g. attaching monitoring or adjusting cannula).

Events such as phone calls or noise from other patients were recorded as background noise as long as they did not halt the post-operative handover. If the handover process was halted then the event was classified as a distraction. Examples of distractions included the arrival of a staff member looking for the controlled drug cupboard keys; the removal of the

anaesthetist to assist a recovery nurse with another patient and the transferring patient waking and requiring extubation. If the handover coincided with other work such as searching for documentation; the attachment of monitoring equipment or the attachment of fluids, the episode was coded as concurrent tasks.

Akin to other related methods, it is important to recognise that these 'glitches' may not directly impact the process outcome, however it is conceivable that they increase the operative demands of those transferring information and as such can be considered to be detrimental to the process. It is important to highlight that the observations were from a non-judgmental angle. The methodology has parallels with intra-operative glitch counting whereby theatre occurrences or events are recorded if they are deemed to be additional work to the core operative procedure (292).

The handover was timed from arrival in recovery to when the anaesthetist left the patient's side. A smartphone timer was used to document this.

5.2.5 Post-operative handover survey

The survey asked the participants to evaluate the post-operative handover in the following domains: perceived quality, information transfer and safety. In order to achieve correlation between respondents, the surveys were paired, (i.e. the anaesthetists and recovery nurses' handover evaluation forms were compared) however the resultant scoring was confidential. As well as reporting opinions of the post-operative handover on a 5-point Likert scale from strongly disagree to strongly agree, the participants were given the opportunity to record their opinions of the handover in free-text boxes.

The handover was considered to be complete when the anaesthetist walked away from the patient's bedside and returned to the operating theatre. Once the post-operative handover had finished, the key handover participants (.i.e. the anaesthetist and recovery nurse) were

asked to complete a survey as soon as possible (APPENDIX E) (Figure 37). The survey asked them to evaluate the post-operative handover in the following domains: perceived quality; information transfer and safety. In order to achieve correlation between respondents, the surveys were paired, (i.e. the anaesthetists and recovery nurses handover evaluation forms were compared) however the resultant scoring was confidential. As well as reporting opinions of the post-operative handover on a 5-point Likert scale from strongly disagree to strongly agree, the participants were given the opportunity to record their opinions of the handover in free-text boxes.

5.2.6 Documentation content analysis

The medication and anaesthetic charts were reviewed following the post-operative handover. They were assessed for completeness of the core handover components (Table 14).

Table 14 Data collection tool for completeness of handover paperwork[4].

	IOCP (intra-operative care pathway)	Anaesthetic chart	Operation note	Drug chart
Patient label	/1	/1	/1	/5
Airway	/1	/1		
An. technique	/1	/1		IVI Y/N Analgesics Y/N ABx Y/N
An. complications		/1		
Operation	/1	/1		
Op. complications	BL= Tq time =	BL = Tq time =	BL =	
Theatre	/1	/1		
PMH	/1	/1		All meds. Y/N
Allergies	/1	/1		/4
Invasive monitoring	/1	/1		
Plan		/1		

[4] Blacked-out boxes implies data not held on this documentation. Note operation note greyed out as note was dictated and not made available until after the patient was discharged from recovery

Following the handover and prior to the patient being discharged from the recovery ward, the medication and anaesthetic charts were reviewed and a data collection sheet was completed. The documentation was then returned to the bedside. It was intended that the operation note would be reviewed after the handover, however it was the practice in this hospital for the operation note to be dictated, typed and then placed in the notes once it had been printed which generally occurred 24hours after the patient had their operation. This documentation source, though potentially crucial for the smooth transfer of patient care, could not be included in the handover analysis due to its unavailability.

5.2.6.1 Accuracy of handover information

The overarching purpose of collecting pertinent patient data during the operation, at the post-operative handover and the documentation was to attempt to assess the veracity of handover content. The information from the three phases in the patient's pathway would be compared, with particular focus given to whether an information point was present, omitted or incorrect.

The intra-operative, handover and post-operative documentation were observed, with standardised, comparable data points collected. This information was then transferred to a Microsoft Excel spreadsheet to aid analysis of both data transfer trends on a per-patient basis as well as consideration of trends in the pre and post-intervention phases.

5.3 Results

5.3.1 Observation of the post-operative handover

5.3.1.1 Timings of handover

In the pre-intervention period there were three handovers observed without timings being recorded. The minimum handover time was recorded as 0.42 minutes, the maximum at 7.10 minutes; the mean handover time was 2.49 minutes and the median 2.20 minutes.

In the post-intervention period two handovers were observed without timings being recorded. The minimum handover time was recorded at 0.56 minutes, the maximum 8.54 minutes, mean 3.50 minutes and median 3.42 minutes.

5.3.1.2 Accuracy of information at handover

The results demonstrate that there are gaps in different parts of the system (Figure 30)

Some information categories were frequently omitted, both in the intra-operative process, post-operative handover and in the documentation. This is true of the post-operative plan, where the intra-operative observation classified a ‘sharing of the plan’ if the WHO sign-out process was completed. This formalised de-briefing process tended to occur once the final skin closure was underway and the instrument count had been completed. It involved the whole theatre team and summarised the intra-operative findings as well as the plan for recovery (293). Note, one data collection sheet of the paperwork was incomplete hence the paperwork assessment not reaching 100%

Figure 30Figure 30 Completeness of information recorded pre- and post-intervention from intra-operative ("Intra-op"), post-operative handover ("Post-op") and documentation ("Paper") analysis

In order to examine the presence of a 'Swiss Cheese' in the information categories, the procedures were considered individually (1). There were more instances of omission during the pre-intervention period, with the post-operative plan being the most frequently omitted (97% pre-intervention vs 55% post-intervention).

Table 15 Percentage of data items missing from at least two sources, from: intra-operative events (intra-op), post-operative handover (post-op) and documentation (n=11).)[5]

	Patient name/label	airway	anaesthetic technique	anaesthetic complications	operation	operation complications	theatre	PMH	allergies	invasive monitoring	plan
Intra & handover	3	3	0	0	0	0	6	0	3	0	21
Handover & doc	0	0	0	0	3	0	0	0	3	0	15
Intra & doc	0	0	0	0	0	0	0	0	0	0	62

With regards to error, there were multiple episodes of incorrect information at transfer during the pre-intervention period. The intra-operative observations were incorrect in the following ways: anaesthetic complications, instance of atrial fibrillation not noted and allergies: no known allergies declared or no sharing of allergies in 30% of cases (including allergies to analgesics, antibiotics and antiemetic). No instances of error were observed

[5] Intra: intra-operative; Doc: documentation

during the observation of the post-operative handover. There were 2 instances of error in the documentation, with allergies to medication not being noted.

In the post-intervention period, there was one instance of error during the intra-operative observation with one allergy to penicillin not being noted. There were no instances of error in the handover or documentation in the post-intervention period.

5.3.1.3 Glitches

5.3.1.3.1 Pre vs post-intervention

Of the 34 pre-intervention observations, 24 had at least one glitch episode. The minimum number of glitches was 0 per handover; the maximum was 7 per handover, mean 1.2. Of the 11 post-intervention observations, 6 had at least one glitch episode. The minimum number of glitches was 0 per handover; the maximum was 2 per handover, mean 0.7 (Table 16).

Table 16 Percentage of glitches, pre and post intervention

	Percentage with no glitches	Percentage with glitches		
		background noise	process interruption	concurrent tasks
Pre-intervention (n=34)	35	32	29	62
post-intervention (n=11)	45	36	36	0

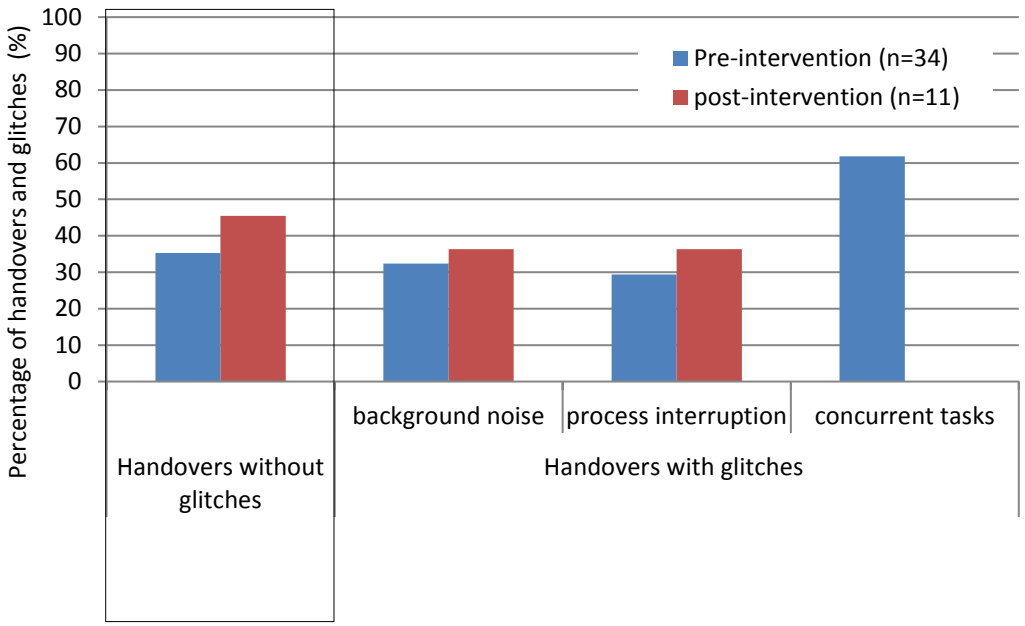

Figure 31 Percentage of handover with or without glitches

In order to test whether there was statistical difference between the pre and post-intervention groups a Fisher's exact test was performed. There was a statistically significant difference seen within the concurrent tasks group (value 6.72)p=0.048.

An example of one patient's handover included the following glitches over a 4:42min period: phonecall; interruption from other RN; crying from another patient; shift discussion with RN; putting on BP cuff during handover; RN asking about notes, none available, notes delivered later by scrub nurse; sorting venflon (drip/cannula).

5.3.1.4 Handover of information

5.3.1.4.1 Frequency of information at handover

The information transferred at each handover was recorded and categorised in to super-categories. The data were then de-duplicated (i.e. if there was an information point such as allergies stated at rank position 2 and then again in position 7, the highest ranking order took precedence). Once in super-categories, it was then possible to compare pre and post-intervention handover states. The overall frequency of information points handed over increased from a total of 37% per category pre-intervention to 51% post-intervention (Figure 32). All of the categories improved in handover frequency apart from two categories: operation and invasive monitoring. All other categories increased in the frequency of transfer (Table 17).

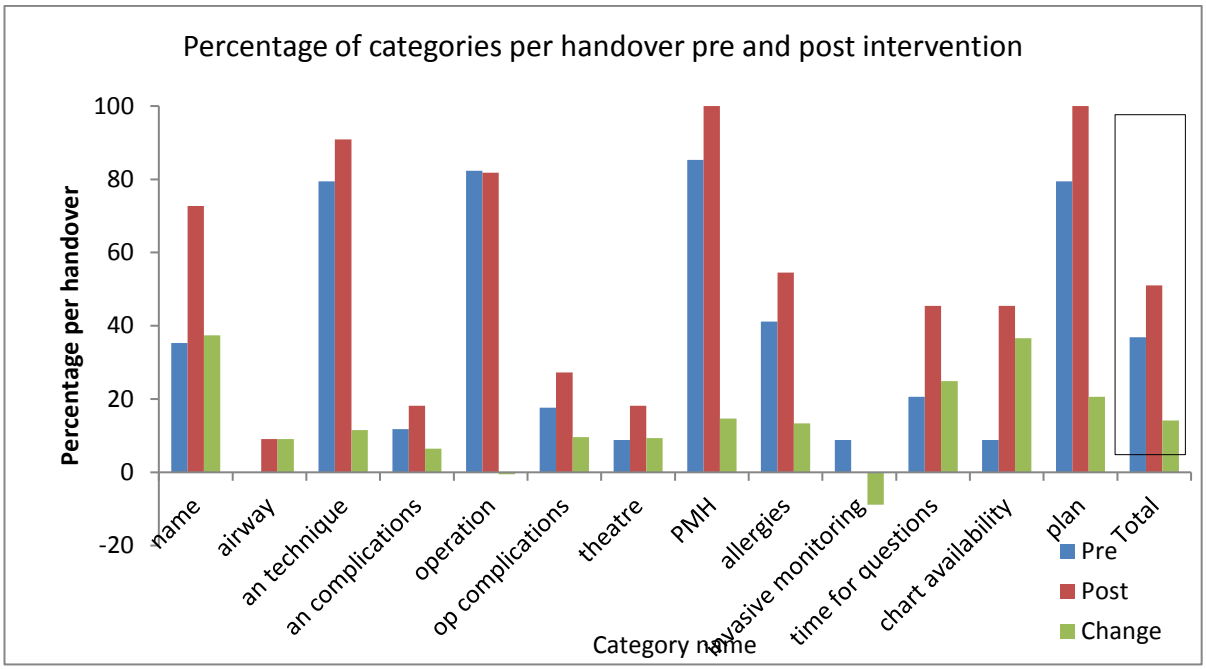

Figure 32 Comparison between pre and post-intervention total data points handed over

Table 17 Frequency of handover information pre and post intervention

	Pre (%) (n=34)	Post (%) (n=11)	Change (%)
name	35	73	37
airway	0	9	9
an technique	79	90	11
an complications	12	18	6.
operation	82	81	-0.5
op complications	18	27	10
theatre	9	18	9
PMH	85	100	15
allergies	41	55	13
invasive monitoring	9	0	-9
time for questions	21	45	25
chart availability	9	45	37
plan	79	100	21
all information transferred	37	51	14

In order to test whether there was statistical difference between the pre and post-intervention groups a Fisher's exact test was performed. There was a statistically significant difference seen between the two groups in the total number of information points transferred (value9.472) p=0.05.

5.3.1.4.2 Rank position of information at handover

When an information category was not handed over in its entirety e.g. *'this lady'* rather than the patient's name, the category was not recorded as being transferred, however as an information bundle was transferred, that rank position was not allocated to the next piece of valid information.

On the occasions where information within a category was handed over in separate sections, the data were de-duplicated. The highest rank position was recorded and the others were removed from the analysis however, the surrounding categories were not advanced in prioritisation. The rank position of handover information changed from before to after the intervention (Figure 33).

The intervention appears to have improved the frequency of information handover. It is interesting to note that unless the patient's name is handed over at rank position one, it is not handed over at all. The other effect of the intervention seems to be to increase the frequency of the title of the operation and anaesthetic technique being handed over.

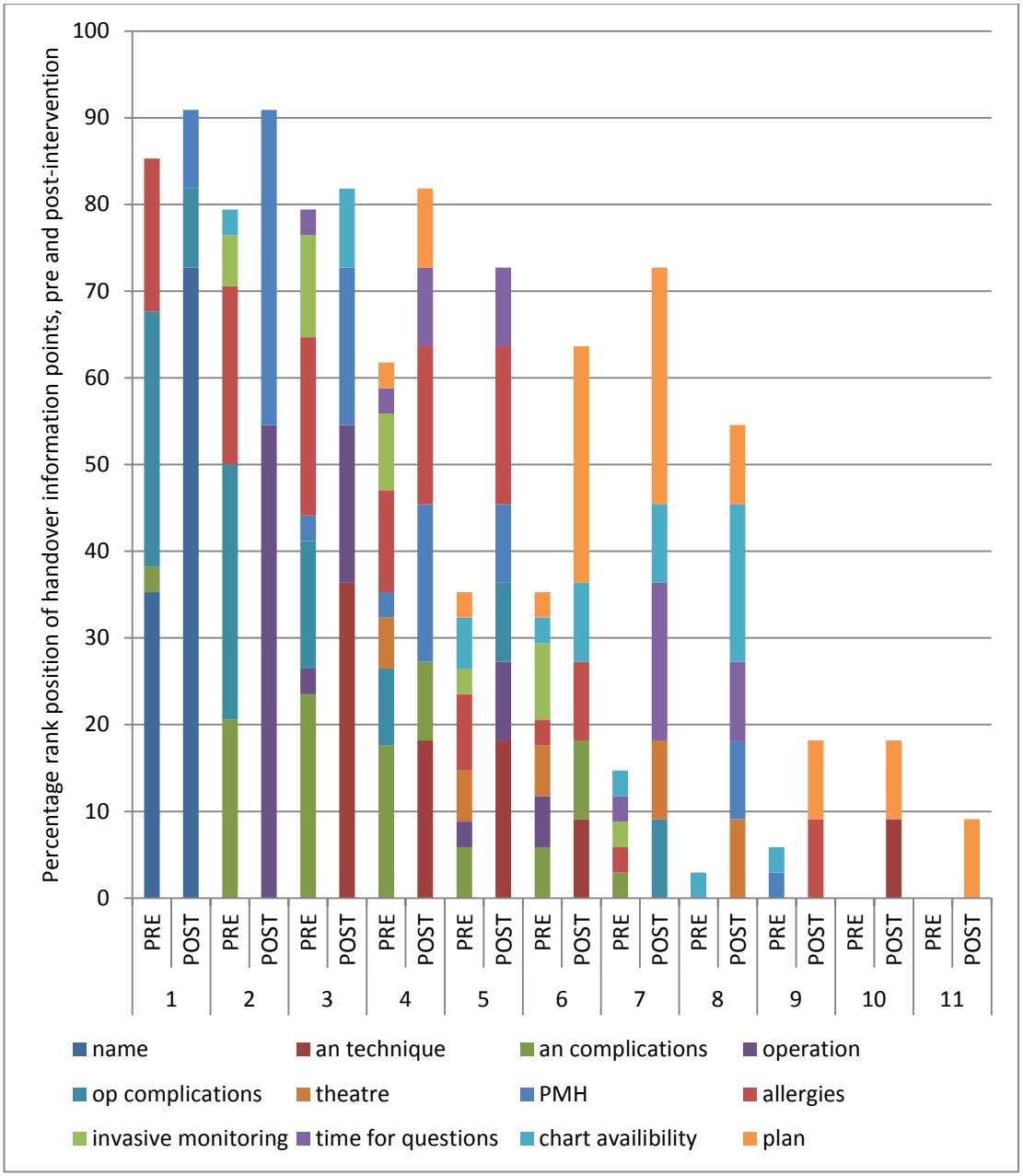

Figure 33 Rank of handover information pre and post intervention

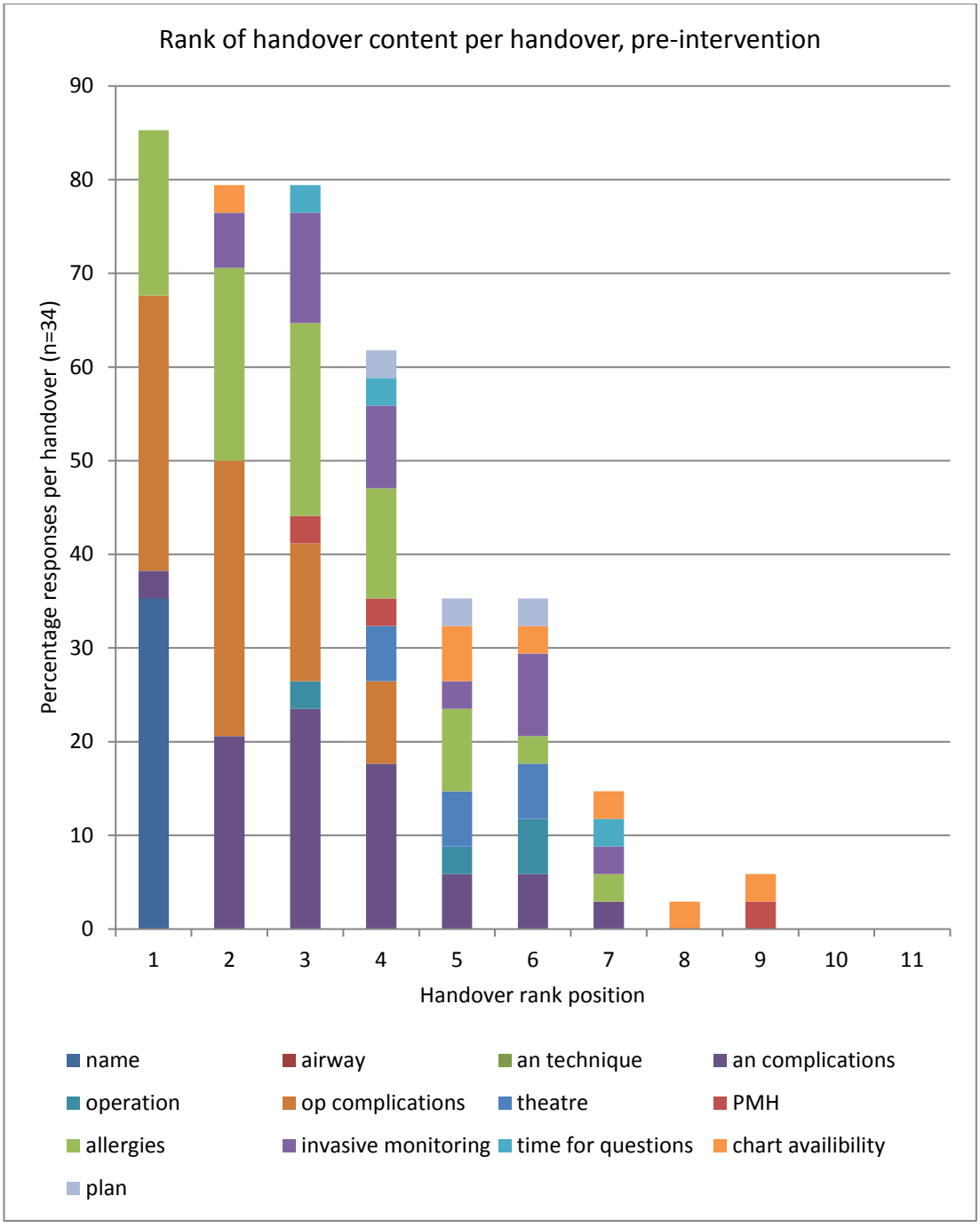

Figure 34 Rank of handover content per handover, pre-intervention, percentage (n=34)

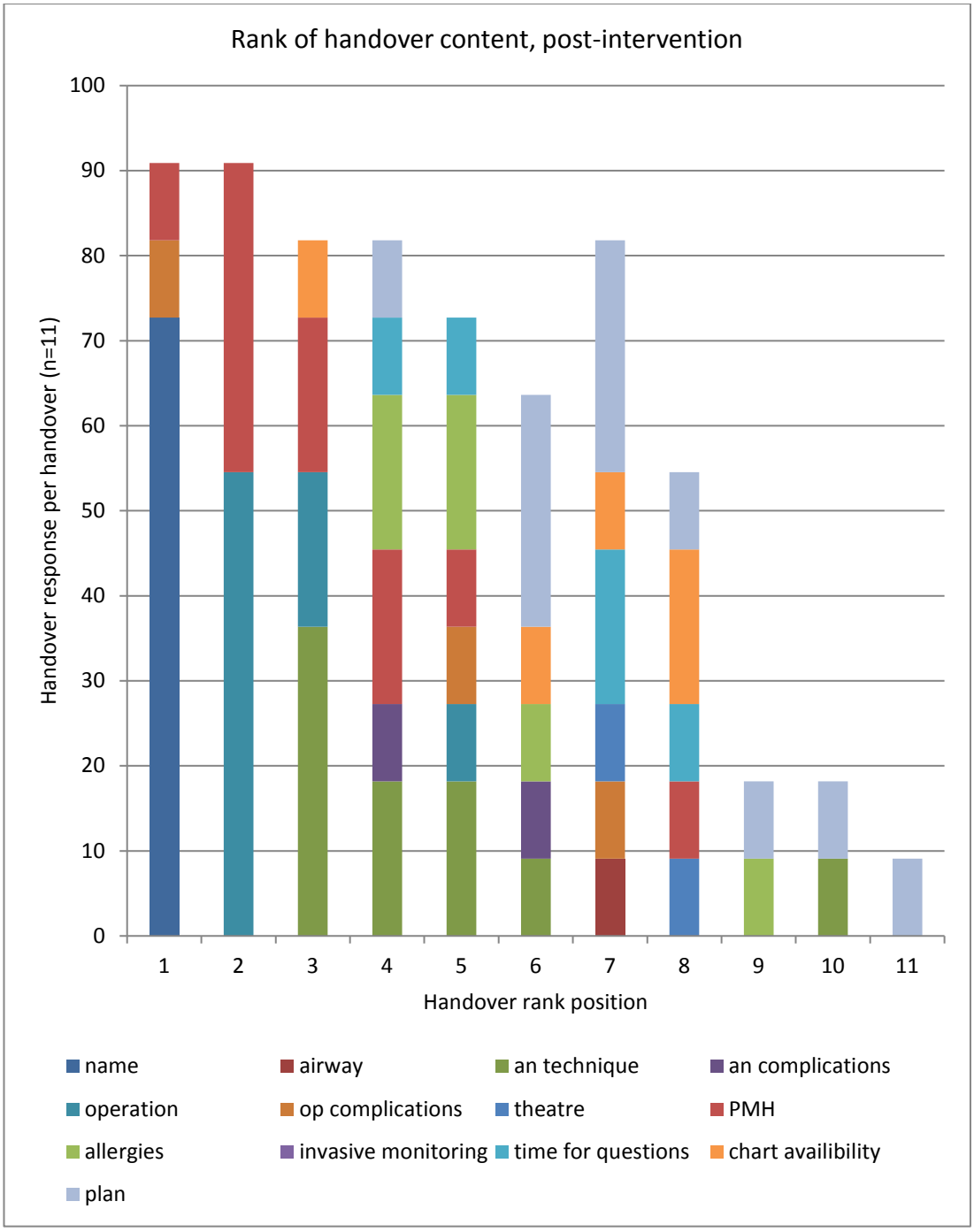

Figure 35 Rank of handover content per handover (post-intervention), percentage (n=11)

5.3.2 Post-handover survey

5.3.2.1 Comments from survey

The comments from the anaesthetists and recovery nurses added to the 'scoring' of the post-operative handover with comments. These were both positive and critical.

5.3.2.1.1 Anaesthetists

A positive comment from one of the anaesthetists included *'aided by experienced recovery nurse'* (AN 16.09.11.310). Two of the anaesthetists commented on specific aspects of their handover with one noting areas of omission (AN 01.09.11.287) and the other that the prescription charts were missing (AN 12.09.11.302). Two anaesthetists were critical of the set-up of the handover with one expressing that they did not know which of the two recovery nurses was taking the handover (AN 01.09.11.286) and the other expressed frustration that the acute pain nurse had not spoken with the receiving recovery team as they had arranged and so prolonging the handover (AN 31.08.11.285).

5.3.2.1.2 Recovery nurses

There were a number of positive comments from the recovery nurses *'anaesthetist checked that I was ready for handover, very thorough'* (RN 07.09.11.299) and *'very good handover'* (RN 12.09.11.302). Three of the recovery nurses commented on specific points of the handover which were omitted (RN 21.10.11.324, RN 24.08.11.278, RN 23.05.13). Two of the recovery nurses noted that there were inadequacies in the handover due to either incomplete or missing information *'despite been told patient is fit, yet had long list of medical problems!'* (RN 16.09.11.310) and *'anaesthetist advised that the patient had a tendency to be 'a bit brady' with no guidance as to what to do'* (RN 08.09.11.295).

5.3.2.2 Survey analysis

The questions were considered in two tranches 'positive' and 'negative' questions i.e. if a handover improved it would be anticipated that the response to the question 'the post-operative handover was of a high quality' would increase on the Likert scale.

5.3.2.2.1 Positive questions

Overall, the intervention appears to have had no effect upon the perception of the handover with recovery nurses or anaesthetists.

Table 18 Positive questions, pre and post intervention survey results: Median, 25th and 75th centile

		Q1 This handover was of a high quality	Q2 I was satisfied with this post-operative handover	Q3 The post-operative handover went smoothly	Q6 The questions asked filled in gaps
Pre-intervention	Anaesthetists	4 (4,4)	4 (4,4)	4 (4,4)	3 (3,4)
	Recovery nurse	4 (4,4)	4 (4,5)	4 (4,4.25)	4 (4,4)
Post-intervention	Anaesthetists	4 (3,4)	4 (4,5)	4 (4,5)	4 (3,4)
	Recovery nurse	5 (5,4)	5 (5,4)	5 (5,4)	4 (4,5)

5.3.2.2.2 Negative questions

Like the positive questions, there seems to be little effect on the responses of the recovery nurses and anaesthetists on the evaluation of the post-operative handover.

Table 19 Negative questions, pre and post intervention survey results: Median, 25th and 75th centile

		Q4. There was information missing	Q7. The handover felt rushed	Q8. The handover COULD compromise care	Q9. The handover DID compromise care
Pre-intervention	Anaesthetists	2 (2,3)	2 (2,2)	2 (2,3.75)	2 (1,2)
	Recovery nurse	2 (2,3)	2 (2,2)	2 (2,2.75)	2 (2,2)
Post-intervention	Anaesthetists	2 (2,2)	2 (2,2)	2 (2,3)	1 (1,2)
	Recovery nurse	2 (2,4)	2 (1,2)	1 (1,3)	1 (1,1.75)

5.4 Discussion

5.4.1 Summary of results

The implementation of this improvement intervention aimed to separate tasks from handover and standardise information transfer. The intervention was evaluated with 5 outcome measures: staff satisfaction; information transfer; information accuracy; handover

length and glitches. The systematic review only revealed two studies which used as many outcome measures to evaluate the impact of a quality improvement intervention, the mean number was 3 (158). The rationale for choosing more than one outcome measure is supported through incident analysis whereby adverse events were rarely recorded in multiple places (52, 53) as well as the theoretical impact of an improvement intervention on outcome measures (296).

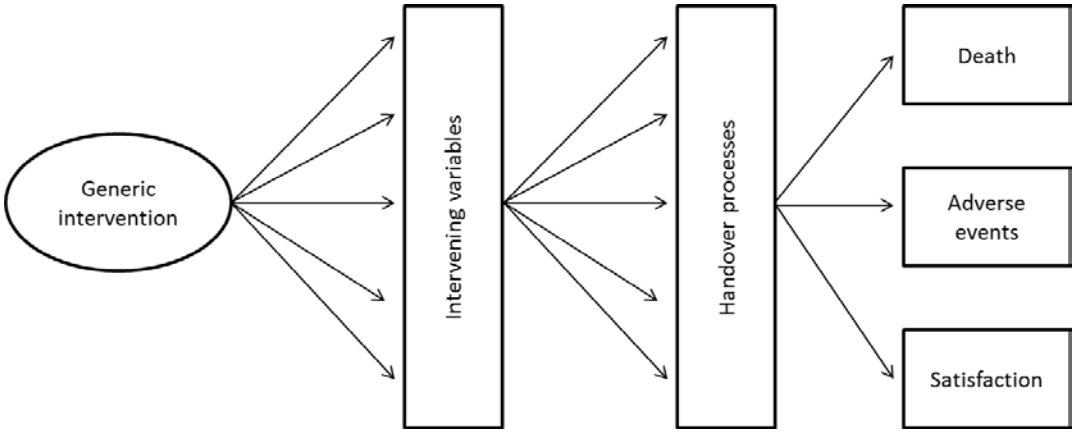

Figure 36 Representation of effect of generic handover intervention (296)

5.4.1.1 Glitches

The post-intervention state showed an overall decrease in 'glitches' (35 – 45% of all handovers without glitches). In particular, there was a statistically significant difference in the concurrent tasks category (reduced from 62% pre-intervention), underlining perhaps that the phased stages of the post-operative handover were being attended to. In comparison to the reduction in multitasking, there was an increase in the prevalence of 'control' glitches following the introduction of the intervention. This may point to the specific focus of the improvement intervention to reduce multitasking. It is not to say that

these glitches are not significant, more that they are often produced at a distance from the handover process rather than directly impacting upon it.

The phased stages of the handover encouraged the separation of task from information transfer. The inspiration for this came from the rather more technically challenging and involved transfer of paediatric cardiac surgery patients (151) and trauma patients (77). In addition to the prompt from the literature, there was a request that this practice be introduced by both the anaesthetists and recovery nurses in the interview study. The separation of task from transfer of information has solid standing within applied psychological research, as the ability to recall information reduced significantly under these circumstances (297). Multi-tasking has been shown to increase the likelihood of medical error by reducing working memory capacity (184-188). Although these facts are undeniable, pressures exist in the transfer of patients in the acute setting to both provide immediate patient care as well as transfer information. These tensions were revealed in the interview study, with the anaesthetists in particular commenting upon the pressure to keep the operating list moving. These tensions have been shown to result in fragmented communication and increase the likelihood of perpetuation of tribal differences (111, 114, 119).

5.4.1.2 Information points

As opposed to the reduction in multi-tasking, there was an increase in verbal transfer of information points (36.8 – 51%). There seemed to be particular benefit in the following categories: patient name (37% increase); chart availability (37% increase); time for questions (25% increase); plan (21% increase to 100%). Overall, the likelihood of all core components being transferred increased statistically significantly from 36.8% to 51%. The improvement in the percentage of information transfer was one of the most commonly reported outcomes in the systematic review, with over 50% of those studies selecting this

as an outcome measure showing improvement (158). It should be noted, that although more information points were handed over, this may not translate to more information recall by the receiving participants. However, the interview study revealed an enthusiasm from the recovery nurses for an increase in number of information points transferred.

With regards to the order in which information was transferred, there was little change. Of note, if the patient's name was not said first, it would not be transferred at all. The operation was stated at rank position 2 and anaesthetic technique at rank position 3 and 4. Allergies tended to be transferred at rank position 4 and 5 and past medical history from rank position 2 – 4. Generally time for questions, chart availability and plan seemed to be positioned towards the end of the handover at rank position 4 – 8.

5.4.1.3 Accuracy of information

The intra-operative process, post-operative handover and pertinent documentation were examined. A comparison was performed between all three components in an attempt to reveal when information points were present, omitted or incorrect. Inspiration for this technique was taken from Reason's Swiss Cheese model (1). It was thought that by examining the three streams of information it would be possible to demonstrate the alignment of gaps or errors in the system. The purpose of the intra-operative observation was to ground the handover and deliver the possibility of examining the veracity of the transferred information. This crucial analytical element is not frequently selected by observers despite its importance.

There were no instances of error in the handover or documentation in the post-intervention period. The reason for this may be a subtlety of coding, as if allergies were not mentioned during the handover, this would have been coded as an omission, however if 'no known allergies' was declared when there were in fact allergies, that would have been coded as an error. It should be noted that instances of omission could be as significant as

overt mistakes e.g. not mentioning at the handover that the patient is allergic to penicillin. There were more instances of omission and error in the pre-intervention than the post-intervention intra-operative, handover and documentation. This implies that there was an increased chance of alignment of error in the pre-intervention period.

5.4.1.4 Handover time

The time for handover increased by 1 minute on average and seems an acceptable price for improved quality. The intervention did not target a reduction in time or efficiency savings. It is encouraging to find that the transfer of more information points with the separation of information from activities did not prolong the handover time. This is similar to the findings from the S3 study where a fully completed WHO surgical safety checklist did not take significantly longer than one which was poorly executed (293).

5.4.1.5 User satisfaction

There was no corresponding change in user satisfaction of the process. The reason for the discrepancy between an observable improvement in the process versus a perceived improvement from a user point of view may be complex. One of the main barriers may be a fear of being perceived to be critical of a colleague's work, however anonymous a survey might be. It could also be that the survey was administered too quickly following the post-operative handover, thereby not giving sufficient time for the recovery nurse and anaesthetist to reflect upon areas which may not have been handed over correctly or whether further information had to be sought following the handover. Another may be that those involved in the delivery of the patient care were unable to objectively view their work or perceive areas which could be lacking.

The other concern was that surveys frequently suffer from a ceiling effect, whereby the rating scale has insufficient range to demonstrate significant improvement following the

change of a process (298). As demonstrated, the pre-intervention satisfaction levels were generally high thus leaving little room for improvement. Another reason for lack of demonstrable improvement may be that there existed higher expectations which were not met by the quality improvement intervention.

This lack of correlation between participant rating of handover quality and observable markers of handover quality has been demonstrated before, although, sub-group analysis on assessment of the patient and acknowledgement of the information were shown to be significant factors (240). It may be, therefore, that broad quality assessments in effect blur the appreciation of high quality handover by including too many irrelevant factors for user satisfaction thereby decreasing significance of findings (240). It may be that a tension exists between the definition of a good handover from a 'sender' to a 'receiver', with one side preferring a monologue and the other having room to ask questions (299). In contrast to Carroll et al., this handover was not between members of the same professional body but interdisciplinary (299). It has been acknowledged that this particular handover requires a unique 'dance' between professionals so as to ensure that face is saved and that professional boundaries are not violated (117).

5.4.2 Intervention

The interview study revealed enthusiasm for some form of standardised transfer of care. The mono-component intervention which was selected encouraged the separation of task from handover. The majority of the interventions included in the systematic review were mono-component interventions (15/29) (158). There was some contention as to whether this would involve a new piece of documentation or checklist, with some strong sentiment that the handover should be different from the intra-operative checklist. The objection to a continuation of an intra-operative checklist may represent a missed opportunity, as considerable success has been found with a patient pathway spanning checklist(300).

However, this would require significant buy-in and reorganisation of current work practice which was unlikely to be tenable on a small scale intervention.

The prompt intervention was designed to increase the standardisation of information transfer and the separation of task from communication. Standardisation as a concept has its groundings within lean process engineering (301, 302). The oft-used quote Masaaki Imai from *"There can be no improvements where there are no standards"* implies that standardisation in itself does not automatically result in change, however it sets expectations which can then be evaluated and targeted for improvement. The standardisation of the post-operative handover was not intended to micro-manage the handover. The protocol did not explicitly require information to be transferred in a strict order, rather left a certain degree of room for interpretation by the anaesthetist. It was thought that by avoiding micro-managing, and permitting variation, acceptance would increase.

The frontline staff were invited to be involved in the development of the final intervention product and were asked how the aid memoire should be displayed, as a tag on their lanyard, poster or printed on the anaesthetic chart. There seemed to be some enthusiasm for a poster displayed above the bed space. It was thought that the very act of involving the frontline staff in the development of the intervention would increase the likelihood of buy-in (302).

5.4.2.1 Critique of the intervention

The interview and intervention studies were performed in one UK specialist hospital. It should be acknowledged that the study of handover in particular is frequently affected by this particular limitation of site, with the majority of studies included in the systematic review only representing the experience of one geographic location. The issues of study transference and outcome reproduction is one which raises concerns within the handover

and quality improvement literature, with some academics considering that the interworking of improvement interventions with their environments make any attempt at subsequent transference futile, however, I, along with others feel that with adequate description of the intervention and environment, meaningful lessons can be relayed and outcomes transferred (208). It is anticipated that by describing the peculiarities of the local environment and task that core messages can be related to other clinical areas and handovers. It is thought by selecting an inter-professional handover, arguably the most challenging patient transfer due to educational and professional differences, improvement interventions could be related to other clinical areas.

5.4.2.1.1 Intervention deployment

A layer of complexity with quality improvement interventions is the role of the context upon the intervention and whether the findings which are shown here could be repeated. This question is particularly pertinent within the study of handover as each handover could be considered to be unique in its attributes. Post-operative handover interventions have previously been specifically tailored to the specific pathology in question i.e. paediatric cardiac surgery (151, 153), general surgery (156) or intensive care (124). By contrast, the aim of this intervention was to develop a handover prompt which would be suitable for all post-operative handovers. The generation of the prompt points was based on the interview study where the interviewees were asked what components would be of use in all handovers. This question is akin to that asked of emergency department staff in the development of their handover intervention (125).

An argument could be made that there can be no effective transfer of knowledge or improvement interventions to other healthcare settings. The environments are likely to be so different as to be hostile to new or foreign ideas or there will be unique attributes from each environment which will make the intervention invalid. This ‘host reaction’ has been

demonstrated through the introduction of national mandated quality improvement interventions (303). The advent of standardised reporting goes some way to ensure that both the improvement intervention and local environment are described in sufficient detail as to enable future researchers and healthcare professionals to transfer learning to their situation.

It should be noted that time was spent establishing positive working relationships with all interested parties. The observer and coordinator of the intervention had spent time working clinically in the hospital in question as well as developing working relationships throughout the initial stages of the research project. It is thought that these relationships could bias the introduction of the intervention, either in a positive or negative way. It is conceivable that if the staff were supportive of the investigator they would be more likely to go through with the intervention but the opposite is also true.

5.4.2.1.2 Study design

The timing of the phases of pre-intervention data collection, intervention and post-intervention data collection was influenced by the organisation and introduction of the parallel larger multi-site study (S3) (246). However, it was felt that there would be little harm in prolonging the time between the implantation of the intervention and the eventual evaluation. In many quality improvement studies, there is little delay between the completion of an intervention and the evaluation. It is therefore not known how long these interventions would persist once the quality improvement paraphernalia had been removed.

5.4.2.1.3 Outcome measures

Ideally, alongside the introduction of the quality improvement intervention, a set of control observations would be collected. As the hospital in which the intervention was being introduced was small, it was not practical to undertake a meaningful control, unless there

was concern that a national macro-generated intervention was going to filter down and affect the post-operative handover in this particular hospital.

5.4.2.2 Future iteration of intervention

An additional enhancement which would improve accuracy would be to hand the patient over by referring to the patient's wrist band which records the patient's name, date of birth and unit number. This would aid the orientation of the recovery nurse as to the name and patient age whilst reinforcing the practice of referring back to a reliable, standardised source of patient details.

There would have been scope to introduce an intervention which would negate the need to attach patient monitoring. However, this may impact upon the direct acknowledgement and recording of observations by the receiving team as the act of attaching monitoring may form a proxy prompt.

Should there be funds, it would be preferable for the patient to be transferred from the operating theatre to the recovery room attached to a monitor which could then be positioned in the patient's bed space. A new monitor could then be taken from that bed space back to the operating theatre. This would enable constant monitoring of the patient as well as reduce the time required to perform Phase 1 and therefore the temptation to violate. Another alternative could be to mandate the presence of another recovery nurse, however this could add more error to the process as it would require the clear allocation of roles, with the anaesthetist needing to know who would be caring for the patient after the handover. It would also require increased coordination of work within the recovery department and allocation of staff for this new work model.

intervention and the context in which it was developed are adequately described to enable transference to other environments (208).

As with all interventions which require observation of work, there is the risk that the presence of an observer effects the behaviour of those being watched (304). In this study, the observer (ER) was the same both pre and post-intervention. It could be thought that those being watched were invested in the intervention and were keen to show improvement following its introduction. An alternative could have been to increase the number of observers or to have an independent observer. It was thought that the bed space was too restricted to have more than one observer. Alternative methods for data collection could include video or audio recording which could be later de-coded however these require acceptance from the frontline staff and may produce the same reaction as direct observation (305).

5.4.3 Future work

The study does have design weakness with the uneven sample size being the most challenging, especially when demonstrating statistical significance. The overall numbers of handovers observed was less than the mean recorded in the systematic review (45 vs 103) (158) The reason for the low numbers was logistical constraints on post-intervention evaluation due to staff constraints in competing study observations. In addition to this the evaluation process was time consuming, with the whole pre-handover procedure being observed and intra-operative data being collected to aid contextual evaluation of the process. This increased the burden of handover evaluation.

Alternate methods which would have increased the number of handover observations include pre-operative data collection from patient notes (306), or viewing the handover in isolation (117). Although these are recognised methods, it was felt that by omitting the direct observation of the operative process it would be difficult to evaluate, what seems to be an elusive aspect to handover, the accuracy of the information. An alternate method would be to count or record the number of unexpected events or ‘surprises’ following the

post-operative handover which could have been foreseen had the handover been adequate (56). A ‘double checking audit’ was considered whereby the recovery nurses recorded when they had to return to theatre or contact the anaesthetist for further information but this was thought to be impractical. During the concurrent S3 study, there were a number of occasions where the anaesthetist was called from recovery on the phone or asked to go from theatre into the anaesthetic room by the recovery nurse to answer questions or to prescribe further analgesia. These interruptions were included in the glitch intra-operative data collection (292). These instances gave a sense that the handover which had been given was not completely adequate and that the handover, rather than being a definite one-off event, seemed to be a slow relinquishing of authority and responsibility. Taking this method further would be to attempt to capture the downstream effects of the handover on subsequent patient care. It has previously been shown that subsequent handovers increased distortion of information by 22% (307). An alternate method would be to observe or in another way examine how frequently documentation is referred to following handover. A study of transitions of care in the emergency department noted that only 50% of documents were referred to following the handover (115).

In addition to process outcome measures, the evaluation of adverse events could potentially be fruitful. A study found a significant reduction in total error and preventable adverse events (106). However, another study estimated that to capture adverse events related to handover would require the study of 14,000 hospital discharges due to the high signal to noise ratio (296, 308). This would be impractical in a smaller hospital such as the study site.

6 Conclusions

6.1 Key findings

This body of research set out to collate the evidence of improvement interventions in handover, relate these generic findings to the post-operative handover by conducting an interview study and subsequently channel the results of these endeavours in to the design and assessment of a quality improvement intervention. It has been demonstrated that despite significant investment from governing bodies and the research community that the transfer of patients within the hospital setting still generates and perpetuates error. The systematic review (Chapter 2) found a heterogeneous body of research, both in terms of outcome measurement as well as improvement intervention selection. This made formal metanalysis impractical; however it was possible to gather information as to what assessment method as well as quality improvement technique may be most pertinent in the post-operative handover. The interview studies (Chapter 3 and 4) unveiled areas of conflict between those staff members most closely associated with the process in the delivery of a smooth and safe post-operative handover. The areas of work most susceptible to stress included pressure on work due to limitations of time; conflict with tasks and the core task of information transfer. The findings from these studies resulted in the development of a low fidelity staff-lead intervention (Chapter 5) which was shown to improve both the reliability of information transfer as well as reduce incidence of multi-tasking.

6.2 Impact on practice

The provision of ultra-safe, robust healthcare continues to challenge even the most sophisticated and advanced organisations. The advent of work-hour restrictions alongside the modernisation of subspecialised care has increased the number of healthcare

professionals involved in the direct and indirect provision of an individual's healthcare. This modernisation has brought untold benefits, however it has brought the unintended consequence of increased care transitions (67). Handover has been demonstrated to contribute to system error. The mandate for improvement has arisen from a number of sources, including: patient dissatisfaction (59); near misses (57); adverse events (95); mortality (96) and malpractice claims (98, 309).

An optimal handover should prepare the oncoming or receiving operative in a seamless fashion and result in no reduction of productivity or safety (78). The simplicity of these requirements masks the complexity of human interaction which is frequently a core component of the process. Complexities include: professional difference, time pressure and temptation of violations. It has been demonstrated that post-shift change staff are at a higher risk of committing an error (62). In healthcare it has been shown that alterations in the handover process has a direct effect on patient outcome (148, 273).

The post-operative handover is unique in healthcare. The patient is in a particularly perilous position as they recover from sedatives. This means that a potential barrier to harm or to the propagation of 'Chinese whispers' is prevented as the patient, although present at the handover, is generally incapacitated(171). Indeed, the patient could potentially interrupt and disrupt their own care by unwittingly awaking from the anaesthetic during the handover, thus distracting the anaesthetist and recovery nurse from the transfer of information (155). The other technical requirement is monitoring for the potential for treatment of life-threatening conditions such as laryngospasm following extubation (273). Differences existed in the description of a good handover, with anaesthetists keen on proceeding with the process in a timely fashion to enable them to return to the operating list, whilst the recovery nurses valuing a longer handover without

distractions. This finding chimes with what has been previously reported, with differences noted between ‘sender’ and ‘receiver’ requirements (299).

The transfer of post-operative care occurs between professionals of two backgrounds and experience (117). Good working relationships between healthcare professionals has been described as being hard won, relying upon the accumulation of past experience and good will to form a chain of: professional competence to respect and then trust (142, 143). The inter-professional nature of this handover is one which has sparked interest in the literature as working relationships between doctors and nurses have evolved from one of strict hierarchy and deferential behaviour, to one of collaborative working (137, 310). However, it should be noted that despite the recent advances in inter-professional relationships, hierarchy still exists with examples from ethnographic research of nursing staff’s professional opinion being held in lower esteem than physicians (138). Inter-professional communication has been found to form 2% of activity but contribute 37% of errors (149). These challenges were thought to make the post-operative handover vulnerable to the effect of conflict and ultimately poor care transitions.

The interview study revealed that tensions still exist between nursing and anaesthetic staff. The main focus for this tension seemed to be sourced in a pressure of work. The anaesthetists reported that they felt pressurised to keep the operating list going, leaving the patient in recovery potentially before they were optimised. The surgeons seemed oblivious to this pressure, rather emphasising that the handover should be done to the anaesthetist’s and recovery nurses’ satisfaction. The recovery nurses expressed frustration with the question ‘happy’. Some of the recovery nurses did not feel that they were fully responsible for the care of the patient in recovery and that they should be able to contact the anaesthetist for further support and advice if needed. This finding has been previously seen in the context on interdisciplinary handover with the concept of ‘face saving’ being

seen to be important on both sides (117, 137). It is intriguing that this very innocuous question could raise such inter-professional feeling, however, its roots lie not in the genuine question of whether the nurses are satisfied but more requesting permission to leave the patient and continue with the operating list.

It is anticipated that care transitions will continue to provide interest for researchers with broad academic and methodological background. Medical care is becoming increasingly sophisticated and subspecialised necessitating corresponding investment in intentionally designed and robust systems of work. The handover improvement method described in this body of work relied solely upon the humans in the system to alter their working practice. Despite the potential weakness of this approach it was possible to demonstrate improvement in both information transfer and a reduction in concomitant tasks. The intervention was low cost however it is vulnerable to deviations in practice due to the temptation of violations. It is thought that fruitful research could be undertaken in developing handovers which enable the transfer of information and responsibility using more than one method, thus designing resilience in to the system. In the post-operative handover this could translate to: the utilisation of patient barcodes to identify patients; digital patient records which self-populate handover sheets; technological advances in patient monitoring and equipment design to reduce the temptation to undertake concurrent tasks.

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Appendix A

Table 20 Data extraction protocol for systematic review

CONTEXT
Number of hospitals
Medical speciality setting
Type of handovers
STUDY TYPE
Study design
Timeline (observation, intervention and follow-up)
Outcome measures
INTERVENTION TYPE
Person
Teamwork training (TwT) classroom
TwT coaching
Video-reflexive techniques
Medical supervision
Information System
Standard Operating Procedures (SOP/protocol)
Minimum dataset (including checklists)
Mnemonics
Wider System
Information Technology (IT)
Continuous Process Improvement (CPI)
OUTCOMES
Measures of information transfer (information transfer, error, forgotten tasks)
Measures of satisfaction with the process (staff and patient)
Measures of compliance with the pre-specified protocol for the handover
Duration (handover length, time to treatment and overtime requirements)
Clinical outcomes (adverse events (AE) and patient outcomes)

Table 21 Studies categorised by intervention

		Outcomes: Adverse events (AE) and Patient outcome data (PoD)	Information: Information transfer (Info); Error-data/investigation/tasks (Error) and Forgotten tasks (Forgot)	Compliance: Legibility of handover (Legibility); Teamwork; Observation data (Observation); Tasks during handover (Task) and Use of intervention (Use)
Information: mnemonic; SOP/Protocol; minimum dataset	(232)	-	Info: increased from 9.2-10.4 (p=0.004)	-
	(213)	-	-	-
	(223)	-	Info: missing or wrong information decreased from 3.4-1.2 (p=0.003)	-
	(153)	-	Info: omissions decreased from 6.33-2.38 (p=<0.0001)	Observation: technical errors decreased 6.24-5.57 (p=<0.0001)
	(235)	-	Info: omission from 36.8-15.7 (NS)	Observation: interruptions decreased 4-1
	(210)	-	-	Use: no change
	(151)	PoD: no change	Error: no change (NS)	Observation: omissions decrease from 2.09-1.07 (NS) Team performance: no change
	(234)	-	Info: omissions decrease from 4-0.45 (p=<0.0001)	-

	(218)	PoD: 'A&C events': reduced from 63/6months to 36/6months (NS)	-	-
	(215)	AE: improved (NS)	-	Observation: improved (NS)
	(212)	-	Info: no change	Observation: no change
	(233)	AE: no change	Info: 14.5-52.3% (p=<0.01)	-
	(225)	PoD: Other outcomes (CPR, ECMO, acidosis) decreased 24-12% (p=<0.001)	-	-
	(226)	PoD: no change	-	-
	(227)	-	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02) Error: accuracy improved (p=0.001)	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02)
	(217)	AE: decreased from 23 to 2	Info: improved (to 85%)	Use: completed checklists: 1/30 to 23/46
	(211)	PoD: no change	Forgot: no change	Legibility: no change
	(228)	-	Info: all improved (p=<0.0001)	Observation: no change Tasks: no change
	(216)	-	Info: decrease in omissions: 77-94%, 30-72%	-

	(220)	-	Info: improved 73-93% (p=<0.01)	-
	(230)	-	Info: mean summary score 6.7-4.9 (p=0.007)	-
	(229)	-	-	Observation: parallel conversations, 11.5-3 (p=<0.001); Info: 78-84% (p=0.02)
Summary		1/8 (12%)	10/16 (63%)	3/13 (23%)
Person: TwT classroom; TwT coaching; video-reflexive; medical supervision	(153)	-	Info: omissions decreased from 6.33-2.38 (p=<0.0001)	Observation: technical errors decreased 6.24-5.57 (p=<0.0001)
	(151)	PoD: no change	Error: no change (NS)	Observation: omissions decrease from 2.09-1.07 (NS)
				Teamwork: no change
	(212)	-	Info: no change	Observation: no change
	(233)	AE: no change	Info: 14.5-52.3% (p=<0.01)	-
	(224)	AE: no change	Error: order errors p=0.003	-
	(227)	-	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02)	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02)
			Error: accuracy improved (p=0.001)	
	(211)	PoD: no change	Forgot: no change	Legibility: no change

	(228)	-	Info: all improved (p=<0.0001)	Observation: no change Tasks: no change
	(230)	-	Info: mean summary score 6.7-4.9 (p=0.007)	-
	(229)	-	-	Observation: parallel conversations, 11.5-3 (p=<0.001); Info: 78-84% (p=0.02)
Summary		0/4 (0%)	7/10 (70%)	3/9 (33%)
Wider system: Continuous process improvement (CPI); IT	(213)	-	-	-
	(219)	-	Forgot: no change	-
	(231)	PoD: reduction in length of stay (p=0.047)	0	-
	(233)	AE: no change	Info: 14.5-52.3% (p=<0.01)	-
	(222)	0	Info: presence of vital components (p=<0.01)	-
	(214)	0	0	Use: no change
	(226)	PoD: no change		-

	(227)	-	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02) Error - data/ investigations/ tasks: accuracy improved (p=0.001)	Info: improved transfer using the SIGN-OUT (p=<0.001) others (p=0.02)
	(221)	Use of intervention: EMR usage from 37-81%, 14-39%	Info: no change	Use: EMR usage from 37-81%, 14-39%
	(211)	PoD: no change	Forgotten tasks: no change	-
Summary		1/5 (20%)	4/7 (57%)	1/3 (33%)

APPENDIX B

Interview study: interview schedule

Thank you for agreeing to be part of this interview study. This interview will be recorded so that it can be transcribed for accurate content analysis. The audio file will be coded and stored anonymously.

The interview should last around 20 minutes. If you would like any question to be explained further; please just ask. There are no 'right' answers to these questions; I am keen to hear your opinion.

Throughout this interview, I will be referring to the post-operative handover. I define this as the point at which the patient is transferred from theatre to recovery, with a verbal information exchange occurring between the anaesthetist and recovery nurse along with transfer of responsibility for the patient. Do you have any questions in relation to this? Are you ready to commence the interview?

1 To start with; can we just run through a few things about your background?

1.1 How long have you worked at the NOC?

2 We are going to consider your role and responsibilities in relation to the post-operative handover process.

2.1 How would you describe your role in the post-operative handover?

2.2 What do you consider to be your responsibilities in the post-operative handover?

3 We are now going to think about the post-operative handover as a whole

3.1 If you could step back from this particular hospital and consider all of your experiences; can you describe an ideal post-operative handover?

3.2 Now, could you describe a 'bad' post-operative handover?

3.3 If you were now to translate this to the NOC; can you describe an ideal handover here?

4 If we now move on to consider the people who you think should be involved in the post-operative handover.

4.1 Who do you consider to be essential in the post-operative handover process?

5 We are now going to focus on the content of the verbal handover.

5.1 What information points do you consider to be essential for all recovering patients?

5.2 The list in front of you contains a summary of handover guidelines; would you like to add anything from this list to your suggestions above?

5.3 How many information points do you think can be realistically remembered following a verbal post-operative handover?

6 We are now going to consider the order of verbal information handover.

6.1 How important is the order in which information is handed over?

6.2 If you were to order the list of essential handover information which you created above, how would you go about it?

7 If we now consider factors other than the content of the verbal handover:

7.1 Are there any 'unspoken' rules which are currently followed during the post-operative handover?

7.2 If you were to define some ground rules to ensure a safe post-operative handover what would they be?

7.3 Like before, can you have a look at the list in front of you and highlight any rules which you consider to be important?

8 Concluding question

8.1 If you were to summarise the top three things which are essential for safe post-operative handover, what would they be?

APPENDIX C

Table 22 Information point prompt sheet for interview study from literature

Information points

This list of information points was shown to the interviewees after they had time to respond to the question: 'What information points do you consider to be essential for all recovering patients?'

- Advanced directives & DNR (311)
- Airway (151, 251)
- Allergies (123, 251, 311)
- Anaesthetic technique (123, 151, 251)
- Analgesia plan (123)
- Antibiotic plan (123, 151)
- Blood loss (123)
- Blood products (151)
- Charts analgesia (251)
- Charts documentation of post-operative plan (251)
- Charts fluid (251)
- Charts medication (251)
- Condition of skin
- Contact number for any surgical problems (306)
- Contact number of person in case of anaesthetic problem (123, 306)
- Current location (54, 282, 311)
- Current status of patient (54, 123, 306)
- Date (311)
- Date of admission (282, 306, 311)
- Date of birth (151, 282)
- Diagnosis (151, 282, 311)
- Discharge/ transfer planning
- DVT prophylaxis (123)
- Escalation plan(282, 311)
- Explanation of the process to the patient (311)
- Expected date of discharge (282, 311)
- Gender (311)
- Hemodynamic (151)
- Infusions (151)
- Input/output (151)
- Intra-operative anaesthetic course + complications (123)

- Intra-operative surgical course and any complications (123)
- Medical record number (MRN) (282, 311)
- Medication plan - drugs to be re-started (123, 282)
- Monitoring and range for physiological parameters e.g. BP, urine output (123)
- Mental state (311)
- NG tube and feeding plan (123)
- NHS number (311)
- On-going plan (311)
- Operation (123, 151, 251)
- Patient at high risk (311)
- Patient details (123, 151, 311)
- Patient name (54, 151, 251, 282, 306)
- Plan for continuous invasive monitoring if required (123, 251)
- Plan for intravenous fluid (123)
- Plan for tubes and drains (123)
- Post-operative investigations (123)
- Responsible consultant surgeon (306, 311, 312)
- Risks/ warnings (311)
- Subjective information about the patient's concerns (313)
- Tasks to be done (282, 311)
- TEE/ECHO (151)
- Theatre number (251)
- Underlying medical disorder (123, 151, 251, 282)
- Ventilation (151)
- What to expect in recovery (123, 279)

Table 23 Rule point prompt sheet for interview study from literature

Suggested rules

This list of information points was shown to the interviewees after they had time to respond to the question: 'If you were to define some ground rules to ensure a safe post-operative handover what would they be?'

- Accurate (314)
- Bleep free (54, 306)
- Brief (delivery) (68)
- Environmental factors – interruptions (54, 68, 282, 306)
- Focused and structured, one speaker at a time (306)
- Level of urgency/explicit timings (54, 282)
- Non-essential work stop (306)
- Note taking mandatory (315)
- Opportunity to ask questions (306)
- Relevant & succinct (54)
- Respectful listening (68)
- Recommend or request more information(282)
- Mnemonic to frame information handover e.g. SBAR (Situation, Background, Assessment, Recommendation) (281, 315)
- Who is responsible? (282, 316)

Table 24 Super-categories of information in handover

1. ABC	ABC, airway, blood loss, blood products, breathing, circulation, current status of patient, escalation plan, haemodynamic, how they are recovering from the anaesthetic, input & output, patient at high risk, ventilation
2. Anaesthetic	Anaesthetic, anaesthetic plan, anaesthetic technique, condition of skin, contact number of person in case of anaesthetic problem, infusions, intra-operative anaesthetic course & complications, intra-operative analgesics, intra-operative events, intra-operative fluids, intra-operative medication, intra-operative fluid management, intra-operative antibiotics
3. Documentation	charts analgesia, charts documentation of post-operative plan, charts fluid, charts medication, documentation of post-operative plan, DVT prophylaxis, fluid plan, medication plan/drugs to be re-started, ng tube and feeding plan, plan for intravenous fluid, plan for tubes and drains
4. Logistics	current location, date, date of admission, discharge & transfer planning, expected date of discharge, family members needed in recover, hearing aid, operation finish time, positioning, responsible consultant surgeon, theatre number, explanation of the process to the patient
5. Past medical history	Allergies, analgesia plan, anaphylaxis, antibiotic plan, assistance required, diagnosis, mental state, risks & warnings, subjective information about the patient's concerns, underlying medical disorder
6. Monitoring	monitoring and range for physiological parameters, neurovascular observations, observations, plan for continuous invasive monitoring, specific concerns compartment syndrome, transfusion trigger, what to expect in recovery
7. Patient demographics	Age, date of birth, gender, medical records number, NHS number, patient details, patient identity, patient name
8. Documentation	advanced directives & DNR
9. Surgical	contact number of person in case of surgical problems, immobilisation plan, intra-operative surgical course & complications, length of procedure, on-going plan, operation, side of the operation, post-operative investigations, tasks to be done
10. Monitoring	TEE & ECHO

APPENDIX D

Table 25 Super and sub categories, information points for all respondents (n=25)

Super-category		Sub-category	Statement	With sheet	Statement (%)	With sheet (%)
ABC		ABC	3	0	12%	0%
		airway	7	20	28%	80%
		blood loss	11	19	44%	76%
		blood products	4	19	16%	76%
		breathing	1	0	4%	0%
		circulation	1	0	4%	0%
		current status of patient	0	5	0%	20%
		escalation plan	1	8	4%	32%
		hemodynamic	1	13	4%	52%
		how they are recovering from the anaesthetic	1	0	4%	0%
		input & output	1	12	4%	48%
		patient at high risk	0	15	0%	60%
		ventilation	1	7	4%	28%
Sum	13		2	9	10%	36.%

Anaesthetic		anaesthetic	1	0	4%	0%
		anaesthetic plan	1	0	4%	0%
		anaesthetic technique	12	18	48%	72%
		condition of skin	0	10	0%	40%
		contact number of person in case of anaesthetic problem	2	15	8%	60%
		infusions	1	16	4%	64%
		intra-operative anaesthetic course & complications	11	19	44%	76%
		intra-operative analgesics	5	0	20%	0%
		intra-operative events	1	0	4%	0%
		intra-operative fluids	2	0	8%	0%
		intra-operative medication	1	0	4%	0%
		intra-operative fluid management	1	0	4%	0%
		intra-operative antibiotics	1	0	4%	0%
Sum	13		3	6	12%	24%

Documentation		charts analgesia	1	17	4%	68%
		charts documentation of post-operative plan	0	3	0%	12%
		charts fluid	2	16	8%	64%
		charts medication	2	15	8%	60%
		documentation of post-operative plan	0	9	0%	36%
		DVT prophylaxis	1	15	4%	60%
		fluid plan	1	0	4%	0%
		medication plan, drugs to be re-started	4	13	16%	52%
		ng tube and feeding plan	0	5	0%	20%
		plan for intravenous fluid	1	13	4%	52%
		plan for tubes and drains	3	14	12%	56%
		advanced directives & DNR	1	13	4%	52%
Sum	12		1	11	5%	44%
Logistics		explanation of the process to the patient	0	4	0%	16%
		post-operative investigations	0	12	0%	48%
		tasks to be done	0	8	0%	32%
		current location	0	1	0%	4%
		date	0	3	0%	12%
		date of admission	0	3	0%	12%
		discharge & transfer planning	0	7	0%	28%
		expected date of discharge	0	3	0%	12%
		family members	1	0	4%	0%

		needed in recovery				
		hearing aid	1	0	4%	0%
		operation finish time	1	0	4%	0%
		positioning	0	1	0%	4%
		responsible consultant surgeon	1	12	4%	48%
		theatre number	0	8	0%	32%
Sum	14		0	4	1%	18%
Monitoring		TEE & ECHO	0	3	0%	12%
		monitoring and range for physiological parameters e.g.	2	20	8%	80%
		neurovascular observations	0	1	0%	4%
		observations	1	0	4%	0%
		plan for continuous invasive monitoring	0	15	0%	60%
		specific concerns compartment syndrome	1	0	4%	0%
		transfusion trigger	1	0	4%	0%
		what to expect in recovery	1	14	4%	56%
Sum	8		1	7	3%	27%

Past medical history		allergies	4	22	16%	88%
		analgesia plan	8	19	32%	76%
		anaphylaxis	2	0	8%	0%
		antibiotics plan	1	16	4%	64%
		diagnosis	0	11	0%	44%
		mental state	1	14	4%	56%
		risks & warnings	1	10	4%	40%
		subjective information about the patient's concerns	2	9	8%	36%
		underlying medical disorder	21	18	84%	72%
Sum	9		4	13	18%	53%
Patient demographic		age	1	0	4%	0%
		date of birth	3	12	12%	48%
		gender	0	5	0%	20%
		medical records number	0	4	0%	16%
		nhs number	0	3	0%	12%
		patient details	0	10	0%	40%
		patient identity	2	0	8%	0%
		patient name	5	19	16%	72%
Sum	8		1	7	6%	27%

Surgical		contact number of person in case of surgical problems	1	12	4%	48%
		immobilisation plan	1	0	4%	0%
		intra-operative surgical course & complications	6	19	24%	76%
		length of procedure	1	0	4%	0%
		on-going plan	4	10	16%	40%
		operation	15	23	60%	92%
		side of the procedure	1	0	4%	0%
		site of operation	1	0	4%	0%
Sum	8		4	8	15%	32%

APPENDIX E

Post-operative Handover Survey

The investigators studying the post-operative handover process appreciate your feedback on the handover which you were involved in. This survey is OPTIONAL and CONFIDENTIAL. The information gathered from it will enable us to assess and potentially improve these handovers.

If you have any questions please contact Eleanor Robertson (eleanor.robertson@nds.ox.ac.uk). Thank you in advance for your participation.

Please circle your role: Anaesthetist Recovery Nurse Surgeon Theatre Nurse ODP

Please respond to the following statements by circling the most accurate response:

Statement	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree	Not applicable
1. This post-operative handover was of a high quality.	1	2	3	4	5	NA
2. I was satisfied by this post-operative handover.	1	2	3	4	5	NA
3. The post-operative handover went smoothly.	1	2	3	4	5	NA
4. There was information missing from the post-operative handover.	1	2	3	4	5	NA
5. If you felt there was information missing, could you list these on the right.						
6. The questions asked during the post-operative handover filled the gaps in the information.	1	2	3	4	5	NA
7. The post-operative handover felt rushed.	1	2	3	4	5	NA
8. There were aspects of the post-operative handover that **could** compromise patient care.	1	2	3	4	5	NA
9. There were aspects of the post-operative handover that **did** compromise patient care.	1	2	3	4	5	NA

Additional comments:

Figure 37 Post-operative handover survey

Figure 38 Post-operative handover project: update 1

POST-OPERATIVE HANDOVER PROJECT

UPDATE 1 – APRIL 2012

UNIVERSITY OF OXFORD

BEFORE WE START...

As many of you may be aware, I have been undertaking research in to the post-operative handover process at the NOC. I would like to take this opportunity to say thank you for your encouragement and involvement in this work so far.

WHAT'S THE PROBLEM?

Handover has been of interest to researchers in a diverse number of industries including petrochemical and nuclear, transport and healthcare. The interest comes from an understanding that the optimisation of the handover process can lead to a smother and safer delivery of service.

Handover in healthcare has been noted as a point of weakness in the system. Researchers have previously tried to understand handover using many techniques including video/audio recordings, surveys, observations and adverse event analysis.

Attempts to improve information transfer in handover have been tried in many healthcare settings. Change initiatives have included mnemonics, teaching sessions, shift timing change, checklists and protocols.

WHAT IS BEING PROPOSED?

We hope to begin a programme of work in the NOC recovery unit aimed at standardising the way the post-operative handover is conducted between the anaesthetist and the recovery nurse.

The proposed plan is to introduce three phases of handover:

- Phase one – Airway and Breathing assessment, attachment of monitoring
- Phase two – verbal information handover with written documentation review (anaesthetic and drug charts), prompt sheet in developed to aid verbal handover
- Phase three – summing up and questions

It is hoped that this will meet with approval from both recovery nursing staff and anaesthetists. It is also expected that this will be adapted through piloting.

If you have any feedback/thoughts to give on this proposal please contact Eleanor using details overleaf.

FOR MORE INFO....

If you would like to find out more about the background to the research project or you have some questions;

please email: eleanor.robertson@nds.ox.ac.uk

Or call: 07812210218

Many thanks, Eleanor

Eleanor Robertson, Clinical Research Fellow

Quality, Reliability, Safety and Teamwork Unit

Nuffield Department of Surgical Sciences

University of Oxford

John Radcliffe Hospital

Oxford OX3 9DU

Figure 39 Post-operative handover project: update 2

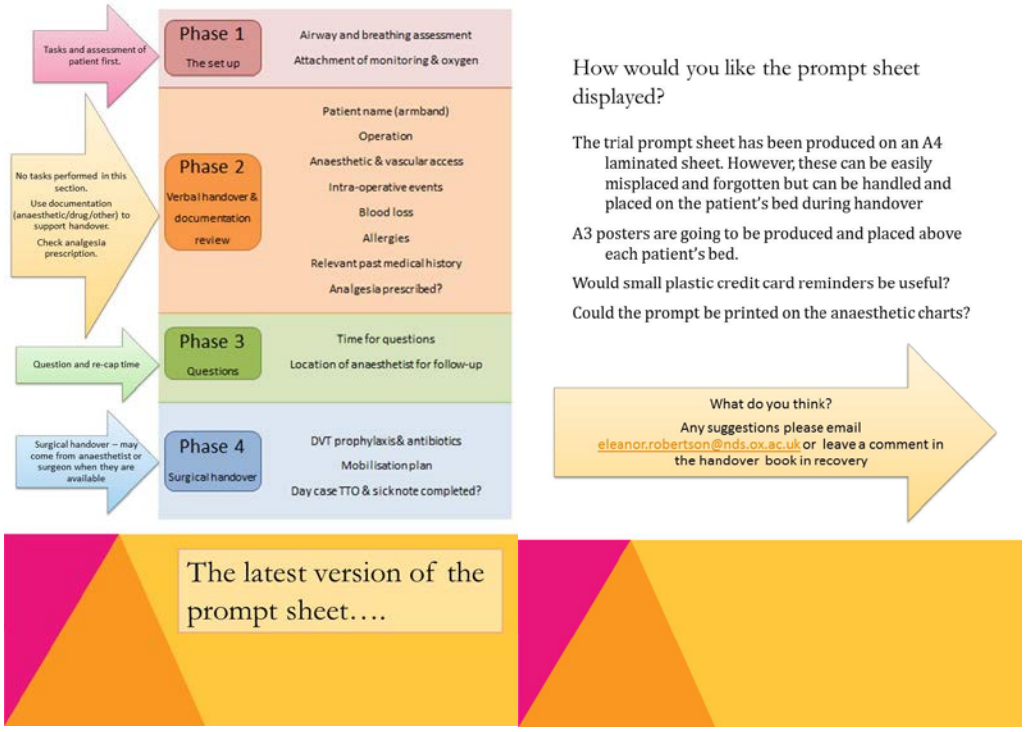
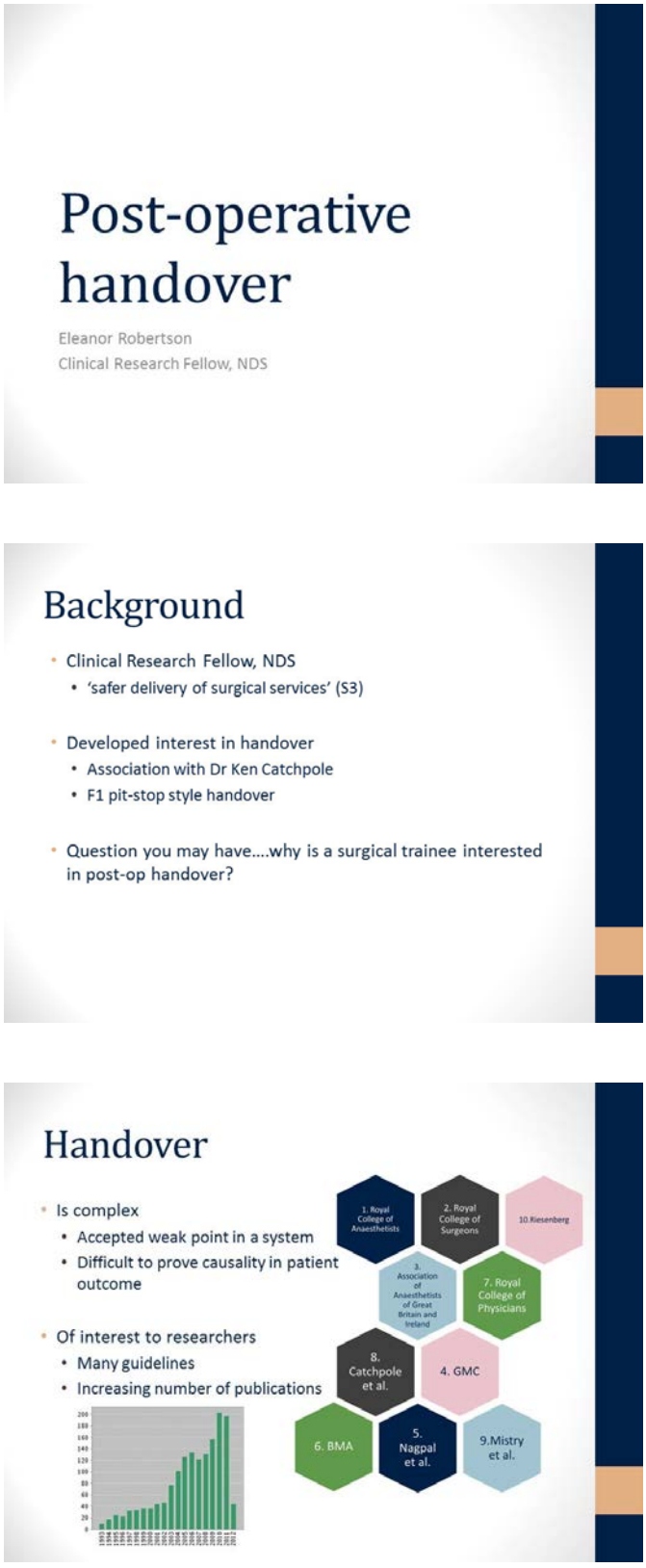


Figure 40 Post-operative handover project: update 3

Figure 41 Presentation to Nuffield Department of Anaesthetics Grand Rounds, July 2012



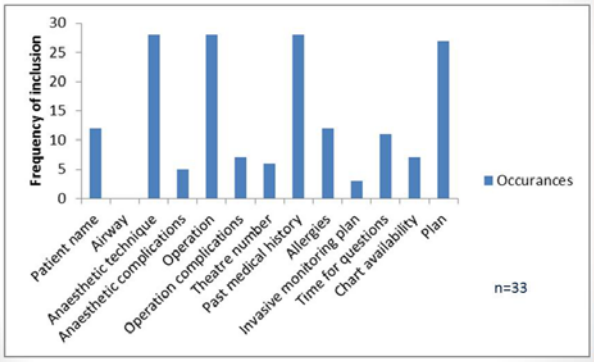
Handover

- Post-operative handover especially interesting

MD

- Investigating the role of interventions to improve the reliability of the post-operative handover
- Approach
  - Understand the literature
    - Systematic literature review
  - What is the current state?
    - Semi-structured interviews
    - 'triple assessment'
  - Opportunity for improvement
    - Intervention development

Selected results – current state



Potential for change?

- Move towards standardisation
  - What can be standardised?
- Separation of tasks and verbal handover
  - Enable recovery staff to give full attention
  - Review of 1st set of observations
- Prompt sheet of minimum dataset
- Use of intra-operative paperwork
  - Orientation of recovery staff to patient progress
  - Assurance to AN that prescription has been completed

Many thanks

- Thank you to everyone who has been involved in the project so far....
- For being patient and interested during the observations
- For giving up your time to be interviewed
- For trailing and commenting on the intervention

So far....

- Separation of task and information
- Time for questions
- Suggested involvement of the surgical team...